2018 | Faculty of Rehabilitation Sciences

UHASSELT

KNOWLEDGE IN ACTION

Doctoral dissertation submitted to obtain the degree of
Doctor of Rehabilitation Sciences and Physiotherapy, to be defended by

Berhanu Nigussie Worku

DOCTORAL DISSERTATION

Children under five living in extreme poverty in South West Ethiopia: Developmental profile and home-based developmental stimulation

Promoter: Prof. Dr Marita Granitzer | UHasselt

Co-promoter: Prof. Dr Patrick Kolsteren | UGent

D/2018/2451/91

“Extreme poverty anywhere

is a threat to human security everywhere”

Kofi Annan

"I believe that if you show people

the problems and you show them the solutions they will be moved to act."

Bill Gates

Members of the jury

Prof. dr. Peter Feys, Hasselt University, Belgium, chairman

Prof. dr. Marita Granitzer, Hasselt University, Belgium, promoter

Prof. dr. Patrick Kolsteren, Ghent University, Belgium, co-promoter

Dr. Liesbeth Bruckers, Hasselt University, Belgium

Prof. dr. Paul Janssen, Hasselt University, Belgium

Prof. dr. Eugene Rameckers, Hasselt University, Belgium

Prof. dr. Caroline Bastiaenen, Maastricht University, The Netherlands

Prof. dr. Lien Goossens, Ghent University, Belgium

Prof. dr. Tefera Belachew, Jimma University, Ethiopia

Printed by Hasselt University, Belgium

This doctoral dissertation is dedicated to my mother ('Shawuu Baqqalaa-Simbirroo Masqalaa'), for her endless and selfless support.

TABLE OF CONTENTS

Table of contents

LIST OF ABBREVIATIONS

ASQ: SE—Ages and Stages Questionnaires: Social-Emotional

ECD—early child development

FM—fine motor

GEE—generalized estimating equations

GM—gross motor

HAZ—height-for-age z score

ICF—International Classification of Functioning, Disability and Health

IRB— institutional review board

LA—language

LAZ—length-for-age z score

MDG—Millennium Development Goal

MRI—magnetic resonance imaging

MUDHCo—Ministry of Urban Development, Housing and Construction

PS—personal-social

RCT—Randomized Controlled Trial

SD—standard deviation

List of abbreviations

SDG—Sustainable Development Goal

SE—social-emotional

SOS—social society

UNICEF—United Nations International Children's Emergency Fund

WAZ—weight-for-age z score

WHO—World Health Organization

WHZ—weight-for-height z score

WLZ—weight-for-length z score

Abstract

Worldwide, over 385 million children under five are living in extreme poverty. Half of them currently live in Sub-Saharan Africa and are at high risk of suboptimal development. The main risk factors are undernutrition, lack of safe water, poor sanitation, restricted learning opportunities and lack of adequate care, as well as inadequate stimulation at home. Because of the intergenerational transmission of extreme poverty, the risks these children are exposed to could even be transferred to the next generations. Rigorous and effective interventions are, thus, vital to curb such intergenerational influences. Nevertheless, to design and implement these interventions, the specific problems of these children need to be identified and documented. Particularly in Sub-Saharan African countries such as Ethiopia, the extent of developmental problems of these children has not been identified and documented for appropriate intervention. Hence, this doctoral dissertation documents two published studies which emerged from a preliminary exploratory study. The former study was also published, but not included in this dissertation. The first study discussed in this dissertation focused on profiling children (3 - 59 months in age; n= 819) in South-West Ethiopia living in extreme poverty by analyzing their developmental, nutritional and psychosocial problems (**Study 1; Chapter 2**). This information was essential to design the home-based play-assisted developmental stimulation, which was implemented and evaluated in the second study of this dissertation (**Study 2; Chapter 2**). This second study targeted children living with their foster families in the context of extreme poverty; because 112 (14%) of the 819 children in study 1 were foster children and, these children carry double burdens. The design of this intervention study was a randomized controlled trial (RCT), with two arms: intervention (n=39) and

control (n=39). Both groups received the basic services (such as a family home, food, clothing, health care, protection and education). Children in the intervention group received home-based play-assisted stimulation in addition to these basic services. Provision of the basic services and stimulation started simultaneously. The intervention consisted of an hour of play stimulation conducted during a weekly home visit for six months. The stimulation activities were carried out by experienced clinical nurses at the children's home, in collaboration with the primary caregivers. At every visit, play materials were brought to the home and left for the caregiver and the child to use. The intervention focused on activities to promote developmental skills and emphasized direct caregiver-child interactions. Caregivers were regularly reminded and motivated to continue practicing the activities and cultural games learned during the home visits. This intervention study deliberately took into account a child's contextual factors (personal and home-environmental factors), activity and participation in the WHO's International Classification of Functioning, Disability and Health (ICF). We preferred home visits and closely working with children's caregivers because we thought their responsive interactions with their children could promote development and wellbeing. We also believed that focusing on caregivers' child-rearing practices could make benefits to the children more likely to be sustainable. Development in personal-social, language, fine and gross motor skills were assessed using the culturally adapted and standardized developmental screening tool, the Denver II-Jimma, and social-emotional outcomes (self-regulation, adaptive functioning, affect, compliance, autonomy, interaction with people and communication behaviors) were obtained using an adapted Ages and Stages Questionnaire: Social-Emotional (ASQ:SE). Information about psychosocial conditions and

sociodemographic characteristics were collected using a structured questionnaire. Anthropometric methods were used to determine nutritional status. The results (of Study 1) showed that children in extreme poverty (n=819) performed worse in all the tested developmental outcomes when compared with age-matched reference children (n=819). Again, in contrast to the reference children, they experienced higher psychosocial problems, such as limited child-child interaction (χ^2 = 90.7, p<0.001), limited mother-child interaction (χ^2 = 116.1, p<0.001), limited play materials (χ^2 = 243, p<0.001), limited playground (χ^2 = 194.2, p<0.001) and limited play time (χ^2 = 12.8, p<0.001). Among the 819 extremely poor children, 325 (39.7%) were stunted, 135 (16.5%) were underweight and 27 (3.3%) were wasted. Stunting and being underweight were negatively associated with all the developmental outcomes. After controlling for the effects of stunting and being underweight on the developmental outcomes, it was observed that limited play activities, limited child-child interactions and mother-child relationships were negatively related mainly to language and gross motor outcomes. This means that these increased psychosocial problems reduced the language and gross motor performances of the children (**Study 1**; **Chapter 2**). At three months (midline) of the intervention study (Study 2), language (P=0.0151, effect size (es) = 0.34) and social-emotional (P<0.0001, es = -0.603) benefits had already been observed for the children in the intervention group. The negative (-) sign of the effect size indicates the reduction in social-emotional problems. At six months (endline), significant intervention effects were found for language (P=0.0014, es = 0.55), personal-social (P=0.0087, es = 0.56) and social-emotional (P<0.0001, es = -1.28) outcomes. For language, the intervention effect depended on the child's sex (P=0.0100); that is, boys benefited more from the intervention than girls

Abstract

(**Study 2**; **Chapter 2**). In conclusion, some children living in extremely poor households were not only undernourished, but they were also experiencing higher psychosocial problems. Both conditions negatively affected their developmental outcomes independently. Further, quality home-based play-assisted developmental stimulation, integrated into basic services, developmentally benefited these children under five in a resource-poor context. On the basis of these results, an implementation of this type of intervention is suggested at the national level.

CHAPTER 1: GENERAL INTRODUCTION

1.1. General background

The United Nations Sustainable Development Goals (SDGs), building on the Millennium Development Goals (MDGs), included the plan to end extreme poverty (SDG1), end all forms of malnutrition (SDG2), promote health and wellbeing (SDG3) and meet quality early childhood development (SDG4, indicator 4.2.1) by 2030. With the principle of leaving no one behind, the 17 SDGs integrated economic, social and environmental indicators [1]. Health and wellbeing (SDG3) was placed at the center of the agenda, because it is linked to targets in many of the other goals [2-5]. For example, eradicating extreme poverty, generating inclusive economic growth, conserving the planet, and improving population health are very much interdependent [6]. Figure 1.1 shows the details. If addressed well, these can help to build physically, cognitively, emotionally and socially competent future generations [7, 8]. However, the realization of these plans may not be easy, especially in Sub-Saharan African countries such as Ethiopia, because of the multifaceted and deep-rooted economic, social, political and environmental problems [9].

Fig.1.1. Health and wellbeing at the center of SDGs (WHO, 2017)

1.2. Definition, causes and burdens of extreme poverty

Extreme poverty is defined as experiencing severe deprivation on two or more dimensions such as nutrition, health, water, education, shelter, sanitation, information and protection [10]. It can also be defined as living below the international poverty line of 1.90 USD per person per day [11]. For this project, both definitions were applicable. This particular type of poverty is inter-generationally transmitted [12]. Such a cycle of extreme poverty persists because it is strongly associated with poor governance, natural disasters, lack of resources, limited social safety nets, fragile health care systems, lack of power, and limited participation in economic and cultural activities [13-15]. People in

extreme poverty are unable to meet basic consumption needs on a sustainable basis and suffer from hunger and malnutrition, poor health, limited education, and marginalization [16]. From a study conducted in 105 countries (75% of the world's population or 5.7 billion) in 2018, a total of 1.34 billion were multi-dimensionally poor people. Among these, 612 million (46%) people live in extreme poverty. Sub-Saharan Africa, with 342 million people living in extreme poverty, accounts for 56% of the world's severely poor. In this context, these people are deprived in the dimensions of health, education and living standards according to the global multidimensional poverty index. This measure incorporates a range of indicators to capture the complexity of poverty (Fig.1.2)[17] .

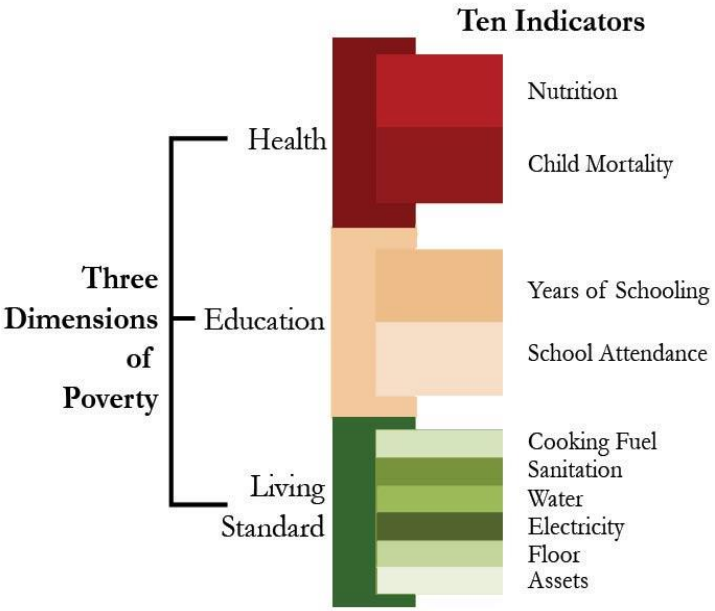


Fig.1.2. Global multidimensional poverty index (OPHI, 2018)

In particular, extreme child poverty should receive specific attention, since these rates are greater than adult extreme poverty rates [18]. Based on data from 89 countries, there were about 385 million children living in extremely poor households in 2013 [19]. According to World Bank data from 2016, half of the population living in extreme poverty are children; and three-quarters (75%) of these children live in Asia and Sub-Saharan Africa [20], including Ethiopia where many households struggle with chronic drought, famine, and malnutrition. The situation is particularly critical in Sub-Saharan Africa, because half of the world's extremely poor children currently live in this region [19]. Among the children living in extreme poverty, in particular, children in foster families experience complex and serious physical, mental health, behavioral, developmental, and psychosocial problems than other children in extreme poverty [21-23].

1.3. Major factors associated with extreme poverty

Children living in extreme poverty are at risk of health problems as well as developmental problems [19, 24]. The main reason for this is that extreme poverty is strongly associated with undernutrition, micronutrient deficiencies, higher morbidity and mortality, as well as psychosocial deprivation such as inadequate stimulation at home [25-29]. These factors may negatively affect child development [30, 31].

1.3.1. Undernutrition

Undernutrition is intensely embedded in extreme poverty [32], and detrimentally affects child development [31]. It also contributes to half of the

estimated six million annual child deaths across the world [33]. In Ethiopia, child undernutrition is still the highest in the world [34]. In this country, feeding practices of only 7% of children age 6-23 months met the minimum acceptable dietary standards, and only 14% of children had an adequately diverse diet in 2016 [35]. Stunting is the most prevalent type of child undernutrition [36]. In Sub-Saharan Africa, one in three children under five is stunted; Eastern Africa hosts the highest proportions [37]. Stunting, which is a chronic problem, remains a major public health concern in this region [38]. Lack of safe water, poor sanitation, and low maternal education are some of the leading risk factors for stunting in the context of extreme poverty [39-42]. Stunting leads to increased childhood morbidity and mortality [43-45], which in turn results in loss of economic output and increased spending on health [46]. It can also have devastating effects on children's cognitive development [47], and in the long term on their educational performance, economic productivity, and mental health [47]. For instance, poorly nourished children tend to start school later, learn more slowly, have lower academic achievement, and perform less well on cognitive tests when older [48]. Furthermore, they have reduced economic productivity [49]. In addition, the annual gross domestic product (GDP) losses from stunting, low weight, and micronutrient deficiencies averages 11% in Africa and Asia [50].

1.3.2. Micronutrient deficiencies

Other risk factors to be considered are nutrition-related components such as breastfeeding and micronutrient deficiencies. Both usually co-occur with extreme poverty. Suboptimum breastfeeding practices, deficiencies of vitamin A,

zinc, iron, and iodine were responsible for about 35% of child deaths and 11% of the total global disease burden [51]. Micronutrients are vitamins and minerals that are essential for human life and health. In low-income countries, poor quality diets and frequent infectious diseases result in micronutrient deficiencies. These deficiencies can largely contribute to mortality, morbidity, and cognitive impairment [52, 53]. Iron deficiency has been associated with cognitive deficits, and zinc deficiency has been linked to low physical activity and depressed motor development among the most vulnerable children [54]. Zinc deficiency may also lead to delays in cognitive development [55]. Lack of iodine during a critical period in brain development is strongly related to limited cognitive capability [29, 56]. Furthermore, it can result in goiter and intellectual disabilities [29]. Severe vitamin A deficiency can cause eye damage and is the leading cause of childhood blindness [56]. It also increases the severity of infections such as measles and diarrheal disease in children and slows recovery from illness [35]. In Ethiopia, for example, consumption of food items rich in iron and vitamin A remains low among young children [35]. In this country, iron deficiency has been one of the primary causes of anemia, which has serious health consequences for children. Fifty-seven percent of children between the ages of 6-59 months were anemic in 2016 [35].

1.3.3. Neonatal morbidity and mortality

Still other factors to be dealt with are neonatal morbidity, mortality and complications, as well as infectious diseases. In impoverished settings, neonatal morbidity and mortality are high [57]. Infectious diseases and neonatal complications are responsible for the vast majority of deaths in children under

five. In Sub-Saharan Africa, approximately 1 in 13 children dies before age five. Ethiopia, together with India, Pakistan, Nigeria, and the Democratic Republic of Congo accounted for half of all newborn deaths in the world in 2017 [58]. In Ethiopia, 62% of births had high mortality risks in 2016. In addition, 1 in 15 children dies before reaching age 5, and 7 in 10 of the deaths occurs during infancy [35]. If current trends continue, with more than 50 countries failing to achieve the Sustainable Development Goal target on child survival, about 60 million children under the age of five will die between 2017 and 2030; half of them will be newborns. Most under-five deaths are caused by diseases that are preventable or treatable with proven, cost-effective interventions [58].

1.3.4. Psychosocial deprivation

The final factor which is highly related to extreme poverty and child development is psychosocial deprivation. Children who live in extreme poverty experience adverse psychosocial disruption, such as limited caregiver-child relationships, little access to play materials and playground, play time, a child's interaction with other children (child-child interaction), and inadequate stimulation at home [59, 60]. Adverse childhood experiences were strongly associated with lower cognitive ability and symptoms of depression and trauma [61-63]. Deprivation in the infant's environment can create permanent deficits in developing neurosensory systems [64]. Past childhood adversities are also associated with developmental risk for subsequent generations of children [65]. Limited caregiver-child interaction is prevalent in the context of extreme poverty, and it may be related to factors such as maternal mental health. Maternal mental health, for instance, can affect the quality of the caregiver-child

relationship and, consequently, the development of the child [66-68]. The relationship between children and caregivers in the early years of life are crucial for the psychosocial development of the children [69-71]. Attachment theory explains this fact very well. The theory of attachment as a secure-base relationship incorporates understandings about affect, cognition, and behavior in close relationships. One of the practical successes based on attachment theory is caregiver-child close interactions [72-74]. Furthermore, children in impoverished environments may experience limited play activities and play time. Children who live in under-resourced settings often face socio-economic obstacles which diminish their right to play time [75], thus depriving them of all the potential advantages of play.

1.4. Multidimensional intervention model for children in extreme poverty

The aforementioned multifaceted and complex problems can only be addressed if multidimensional intervention packages are used. For our intervention in this work, we adopted the WHO's International Classification of Functioning, Disability and Health (ICF) model. This approach can provide a framework for understanding children's level of functioning as a dynamic interaction between their health conditions, environmental factors, and personal factors [76, 77]. Particularly the home-environmental factors were taken into account, as they affect everything and may need to be changed. There are reciprocal relationships between contextual factors (personal and environmental factors), caregivers' participation, tasks, and activities [78]. Understanding the complex relationships between personal and environmental characteristics and positive

childhood functioning can help professionals to enable children's active participation in everyday life activities [79]. Thus, the focus of intervention should be on the individual and the environment the individual lives in—i.e. an interaction of a child with his or her environment (physical and social environment) [80], while also encouraging the participation of caregivers with children by performing activities such as play and interactions together. That was why we focused on home-environment, integrating our intervention into the basic services, caregiver-child interactions and joint performance of various activities based on the child's needs and capabilities. Figure 1.3 illustrates the WHO's ICF model.

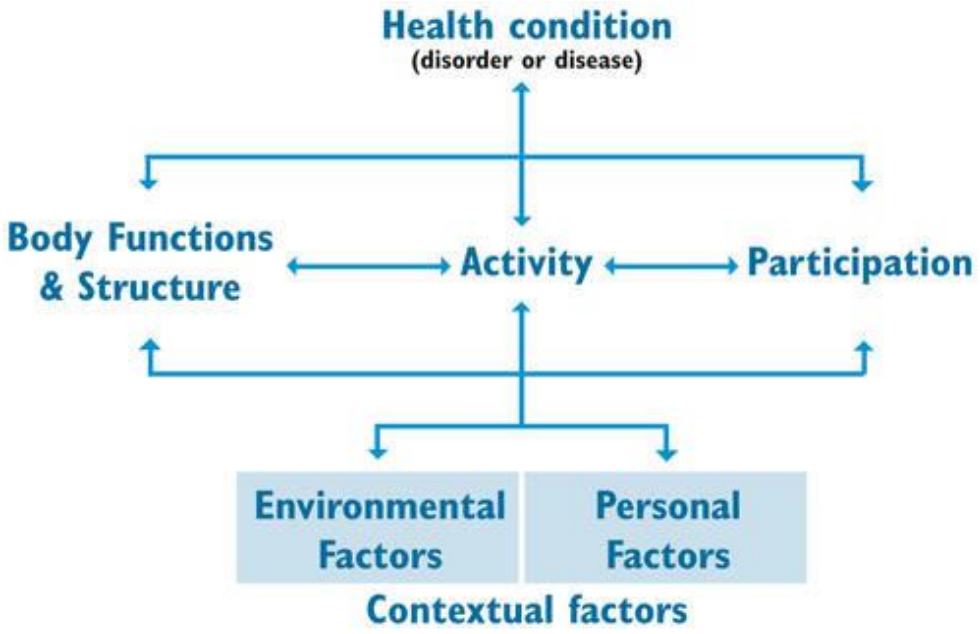


Fig.1.3. Interactions between the components of ICF (WHO 2001:18)

1.4.1. Play-based intervention

In the first five years of life, a child's main way of learning and developing is through play [81]. Child's play is an activity initiated, controlled, and structured by children themselves, and it takes place whenever and wherever opportunities arise, either in group or alone. The key characteristics of play are fun, uncertainty, challenge, and flexibility [82]. The influence of play on a child's holistic development is massive [83]. Developmentally appropriate play with caregivers and peers can promote the social-emotional, cognitive, language, and self-regulation skills that build executive function and a prosocial brain [84]. It is also effective on the metacognitive and behavioral aspects of executive functioning [85]. Further, outdoor physical play at a playground among small peer groups for a relatively longer time enhances children's social competence [86]. Play activities also boost the creativity, verbal skills and child-to-child interaction skills of preschool children [87, 88]. However, the quality and benefits of play are highly susceptible to the environments in which it occurs. For instance, play activities can be compromised by extreme stressors in the environment [89]. Because of their exposure to multiple poverty-related risks, children in extreme poverty may be more prone to high stress, and thus, play-deprivation. High level of stress could also affect a young child's brain and neurophysiological functioning, which leads to a broad range of deleterious health, developmental, and mental health outcomes [90, 91].

Caregivers may contribute to the creation of environments in which play takes place [82]. Their participation in scaffolding children's play is critical in development, while allowing children to direct their own play activities [92, 93].

Nonetheless, because of limited resources, a lack of awareness of the importance of play, and concern for the safety of their children, caregivers may restrict their children's play activities and limit the children's independent mobility and engagement with peers in the neighborhood [75, 94, 95]. In this project, educating caregivers to consider play seriously, and raising awareness about its relevance was the first step. Next, play assisted the interactions between the children and caregivers. In doing so, the caregivers were the primary mediators of the interactions. The developmental stimulation intervention encouraged collaboration between the caregivers and children to improve the children's developmental outcomes in their own home setting.

1.4.2. Responsive stimulation

Responsive stimulation is a kind of parental care which refers to attention being given to the child's body, health, nutrition, emotional, social, language and cognitive development by parents or caregivers [96]. In particular, a responsive stimulation can promote positive caregiving behavior among underprivileged families [97]. Responsiveness is meaningful parenting that is prompt and appropriate to the child's immediate needs, behavior, and developmental state. It enhances the cognitive and psychosocial development of the child. It also protects the child from disease and mortality [98]. Children experience their world as an environment of relationships, and these relationships affect almost all aspects of their development [99, 100]. As Vygotsky stated: social interaction is essential in human development [83]. In addition, attachment theories underscore the significance of close social relationships to child development [101]. Maternal responsiveness and social support are strong

predictors of secure attachment, which is the foundation for optimal development [102]. Particularly, secure attachment is considered as a psychological strength that has important implication for later life [103].

To maximize the responsive parenting and well-being of the child, enough finance is important, especially during the early years of life or early childhood [104]. Early childhood is a period which lays the basis for later life, but it is also a period in which children are at the highest risk [105, 106]. This is the period when brain growth and development are most active. Nerve connections and neurotransmitter networks that form during these critical years are influenced by negative environmental conditions. Emotional and cognitive disruptions in the early lives of children have the potential to impair brain development [107, 108]. Generally, children's experiences during the early years establish a critical foundation for their entire life. This is mainly because early child development intensely influences basic learning, school success, economic participation, and health [109]. This was why the present work followed a multidimensional approach rooted in the WHO's International Classification of Functioning, Disability and Health (ICF)[110].

1.5. The home-based play-assisted stimulation in the present work

Home-based interventions that target both the children's psychosocial functioning and caregiver's practices are effective and vital to improve individual and family adaptation [111]. The identification of developmental, nutritional, and psychosocial problems of children in extreme poverty, and documentation of the evidence of how psychosocial/nutritional factors are related to child

development were crucial to design a cost-effective and scalable intervention—i.e. the home-based play-assisted stimulation. The prevalence of undernutrition and cognitive deficits among some groups of children in disadvantaged contexts was previously reported. However, the status of undernutrition, psychosocial factors, and other developmental outcomes (such as social-emotional, personal-social, language, fine and gross motor skills) altogether is not well known. The efficacy of interventions to mitigate the problems of severely malnourished children was also clear [112-115]. Nevertheless, these pioneering studies were center-based and expensive [116-121]. A comprehensive systematic review of 2017 revealed that even these center-based psychosocial stimulation interventions were of very low quality, and accordingly, high-quality trials were strongly recommended [122]. Further, little evidence of synergistic interaction between dietary therapy and stimulation on child development was reported by any other systematic review [123]. The authors found no rigorous evaluations of adding stimulation to health and nutrition services [123]. There was also no sufficient evidence on the long-term and sustained benefits [123, 124]. Even, most of the aforementioned interventions were from countries in South Asia and, Latin America and the Caribbean. In Sub-Saharan Africa, the region where half of the world's extremely poor children reside, such evidence is highly lacking [125]. Information is even more scarce for foster children, who carry double burdens: living in extreme poverty and without biological families. Well-designed home-based intervention (RCT) may benefit this group of children. Household level early years' interventions can be cost-effective [126, 127], and sustainable [128, 129]. For instance, early childhood interventions that included responsive stimulation were economically more efficient than a nutrition

intervention alone, i.e. the costs of stimulation intervention integrated into a community-based service were minimal [126].

1.5.1. Target children for the stimulation

Most of the children included in the first study (study 1) were living with their extremely poor biological parents in Jimma Town, Ethiopia; about 14% of these children were living with foster families in the same context. For the home-based developmental stimulation study (study 2), children living with foster families in the context of extreme poverty were targeted because it was documented that their situation was worse (**Appendix B**) and thus, they could benefit more from the intervention study. These children were placed in a new family environment, where they might face adjustment and attachment problems. It has already been revealed that foster children's attachment behavior is mainly influenced by foster parents' behavior [130, 131]. The majority of children in foster care experienced adverse conditions and are up to four times more likely to experience health problems [132]. Furthermore, unlike other children in extreme poverty, SOS Children's Village of Jimma has been providing these children with basic services such as food, clothing, health care, protection, and education; thus it was ethically sound to integrate the play-assisted stimulation into the basic services, than to provide the home-based stimulation to children living with their biological parents living in the same context and who were not getting the services. Most of these foster children were orphans. Subsequently, they might struggle with negative past experiences and adjustment and attachment problems. These problems could in turn negatively influence their development and behavior [133-137]. Orphaned

or abandoned children are at high risk of developing insecure attachments. Children with attachment disorders often grow up to vent their rage and pain on society [107, 138, 139]. These foster children might also experience worse psychosocial, health, and nutritional problems [140-142]. Early exposure to sociodemographic adversity in particular could have negative effects on developmental competence and mental health [143]. Providing the basic services alone is not enough for these children. They should receive extra attention and support to meet their developmental needs [144]. After all, developmental outcomes depend on nutrition, stimulation, and caregivers' responsiveness [145-149].

Therefore, to our knowledge, it is not yet clear whether home-based play-assisted stimulation, attuned to the basic services, can benefit children living with foster families in the context of extreme poverty.

1.6. Measuring outcomes of the studies

1.6.1. Developmental outcomes

Taking into account the extremely poor living condition of the study children, appropriate and easy-to-use developmental screening tools were used in this work. These were Denver II-Jimma [150] and Ages and Stages Questionnaire: Social-Emotional (ASQ: SE) [151]. We adapted these tools, to the socio-cultural context of Jimma, for use. The tools were also translated into two predominately spoken languages—Afan Oromo and Amharic—in the study site. Additional information about these tools was presented under sections 2.1.3.4.1 and 2.2.3.4.1.

The Denver-II was reported to be the most feasible and valid multidimensional test [152], and it has been used for repeated measurements (for longitudinal studies) [153]. The step by step adaptation processes and refinement of Denver II test items resulted in the Denver-II Jimma, which comprises 36 adapted and 89 original Denver II items. Inter-rater reliability of Denver-II Jimma was excellent (kappa > 0.83) for all tested items [150]. The Denver-II Jimma was used to directly assess a child's developmental performance on various age-appropriate tasks or items. There are also few items within the test that require the caregivers' report about children's development. The test measures, for children from birth to six years old, four developmental domains: personal-social (PS), fine motor (FM), language (LA), and gross motor (GM). Personal-social is getting along with people and caring for personal needs; fine motor pertains to eye-hand coordination, the manipulation of small objects, and problem solving; language is the production of sounds, hearing, understanding, and using language; and gross motor is about motor control, balance, sitting, walking, jumping, throwing, kicking and overall large muscle movement. Denver II test form can be found under **Appendix F**. The outcomes were operationalized in two ways: developmental performance score and ratio. The developmental performance score is defined as the number of age-appropriate test items of a domain a child has successfully passed. For each child, the developmental performance ratio for each developmental domain was calculated. The developmental performance ratio simply refers to the ratio of the total number of items passed to the expected number of items a child should pass, taking into account the child's age [150]. Children performing lower than what is expected for their age have a developmental performance ratio below one. Throughout this project, developmental performance score, developmental

performance ratio, developmental performance, developmental outcome, developmental domain, developmental profile, and developmental skill have been used interchangeably.

Ages and Stages Questionnaire: Social-Emotional (ASQ: SE) is a parent or primary caregiver completed, child-monitoring system for social-emotional skills [151]. ASQ:SE is a set of eight questionnaires developed to identify, solely based on a primary caregiver's report, children's social and emotional competencies: self-regulation, compliance, communication, adaptive functioning, autonomy, affect, and interaction with people. These seven social and emotional competencies are embedded in each ASQ:SE questionnaire, but not presented as sub-scales as in Denver-II. The social and emotional skills are connected developmental areas. Social competence is an array of behavior that permits one to develop and engage in positive interactions with peers, sibilings, parents and other adults. For example, a 4-year old boy who typically engages and maintains his sibilings and peers in appropriate play, elicits helpful assistance from teachers and parents, and uses positive strategies to solve problems, will likely be seen as a socially competent child. Emotional competence is the ability to effectively regulate emotions to accomplish one's goals. For instance, a 3-year old girl who calms easily after a frightening experience, who controls her anger when disciplined, and who smiles and laughs at funny stories is likely to be seen as emotionally competent [151]. The adapted developmental screening tool was used to assess the social-emotional development of children from three to 65 months. The eight questionnaires of the tool were prepared to be administered at 6 (3-8): 22 items, 12 (9-14): 23 items, 18 (15-20): 29 items, 24 (21-26): 29 items, 30 (27-32): 32 items, 36 (33-41): 34 items, 48 (42-53): 36 items, and

60 (54-65): 36 items, months. One of the eight ASQ:SE questionnaires (60 Month) is attached as an example under **Appendix G**. The child's total ASQ:SE score was calculated by adding up the points of all the items on the questionnaire. A higher total score indicates more social-emotional problems. The adaptation of ASQ:SE was made by a Belgian psychiatrist for children and an Ethiopian psychologist, who later refined the tool in collaboration with other psychologists, paediatricians, and a special needs expert in Jimma University, Ethiopia. The ASQ:SE was then translated into Afan Oromo and Amharic languages by two experts in Jimma University. Cultural adaptation and linguistic translation of ASQ:SE was also effectively done in other settings such as Korea [154]. Social-emotional screening using ASQ:SE increased the detection rate for social-emotional problems among young children in foster care, compared to other screening tools [134]. ASQ:SE was used as a universal screening test, and to assess the effect of interventions on changes in social-emotional scores overtime for 6 to 36 months of age children in a paediatric setting [155]. It was also used for 6,530 three-to-four-year-old children longitudinally followed for two years in public day-care centers in Brazil [156]. The adaptation processes of both Denver-II Jimma and ASQ:SE are not presented within this project.

1.6.2. Nutritional status

Anthropometric assessments were conducted to determine the nutritional status (stunting, underweight and wasting) of the study children. The details are presented under method (2.1.3.4.2 and 2.1.3.6 subsections).

1.6.3. Psychosocial factors

Psychosocial factors, along with sociodemographic variables, were assessed using a questionnaire. These factors include a child's interaction with other children (child-child interaction), caregiver-child interaction, availability of play materials, playground and play time. For data analysis, these variables were used in their binary forms (yes or no; 1 or 0). The items within the questionnaire are presented under **Appendix E**.

1.7. Aims of the studies

In recent years, many interventions related to early childhood development have been conducted in low and middle-income countries (LMIC). These studies have mainly targeted children in poverty. The most disadvantaged children, in extreme poverty, have rarely been considered, and thus, trials of high quality are still lacking for these children. Within this context, we focused on this particular population and as the first step identified their developmental, nutritional, and psychosocial profile, and investigated the relationship between psychosocial factors/nutritional status and developmental outcomes. This was done on 819 children under five years (112 children were living with foster families in the same context), registered as living in extreme poverty by the Women's and Children's Affairs Office (WCAO) of Jimma Town (**Study 1**; **Chapter 2**). In the second step, we examined the effect of a home-based play-assisted stimulation on the developmental performances of children living with foster families in extreme poverty (**Study 2**; **Chapter 2**). This stimulation intervention was integrated into the basic services provided by the SOS Children's Village. Basic services, i.e. a family home, food, clothing, health care,

protection, and education, were given to both intervention (n=39) and control (n=39) children, whereas the home-based play-assisted developmental stimulation was given to the intervention group alone. The stimulation lasted for six months (24 sessions for each child) and consisted of weekly one-hour play and skill-transfer session with a caregiver and child, facilitated by clinical nurses. These nurses trained and transferred parenting and play skills to the caregivers to help them sustain their interactions with the children through play. Provision of the basic services and stimulation to the intervention children started simultaneously.

Language, personal-social, fine, and gross motor performances were tested using Denver-II Jimma, a version of the Denver II adapted to the socio-cultural context of Jimma zone [150]. Social-emotional skills were assessed using the Ages and Stages Questionnaire: Social-Emotional (ASQ:SE). Nutritional status was determined using anthropometric methods. Psychosocial and sociodemographic information was collected using a structured questionnaire. Assessments were made three times: at baseline, at three-month (midline) and at six-month (endline). The overall assessments took about one hour per child and were done by trained and experienced clinical nurses. Further, to address the multifaceted nature of this research project, a multidisciplinary team consisting of a psychologist, a special needs educator, a nutritionist, physiotherapists, occupational therapists, a pediatrician and a neuroscientist was involved.

1.8. Overview of the studies

The ultimate goal of this project was to examine the effect of home-based play-assisted stimulation, integrated into basic services, on the developmental outcomes of children under five living in the context of extreme poverty in South-West Ethiopia (Jimma Town). Within the group of children in extreme poverty, children living with foster families were targeted. For these families, a foster care program was initiated by SOS Children's Village of Jimma, in collaboration with Jimma Town Women's and Children's Office in October 2015, after the village could not enroll children from extreme poverty any more. The intervention study was designed taking into account the profile of children in extreme poverty documented in the first study, and the existing literature. The two studies (reported in Chapter 2) were published in BMC Pediatrics in 2018. The first was a community-based cross-sectional study intended to investigate the developmental outcomes, nutritional status, and psychosocial factors of children living in extreme poverty. The second study was a randomized controlled trial aimed at evaluating the effect of the stimulation on developmental performances of children under five living with foster families in an extreme poverty setting. The two studies are presented in more detail below.

Study 1: The relationship of undernutrition/psychosocial factors and developmental outcomes of children in extreme poverty

Personal-social, language, fine motor, gross motor, and social-emotional skills were the primary outcomes measured. Nutritional status, demographic characteristics, and psychosocial conditions were the other outcomes assessed. Profiling these outcomes and examining their interrelations was important to

design a longitudinal stimulation study and evaluate its effect on the developmental outcomes of the children. It was hypothesized that children in extreme poverty would score lower on both developmental outcomes and psychosocial factors than reference children. In addition, it was expected that undernutrition and psychosocial factors would significantly relate to the developmental outcomes, independently. The study revealed that children living in extreme poverty performed less well in all the developmental and psychosocial outcomes. Further, undernutrition (stunting and being underweight) and psychosocial factors (limited child-child interaction, limited caregiver-child interaction, limited play materials and playground) negatively affected the developmental outcomes independently.

Study 2: Effects of home-based play-assisted stimulation on developmental performances of children living in extreme poverty

In the previous study, profiling the nutritional status, psychosocial factors and developmental outcomes and, scrutinizing their relationships helped to design a randomized controlled trial. This second study addressed the effect of a home-based play-assisted stimulation on developmental performances of foster children living in extreme poverty. This longitudinal study comprised two groups: intervention and control. Children in both groups received basic services (food, medical care, education and protection). A weekly one-hour developmental stimulation was additionally provided to the children in the intervention group for six months (24 sessions per child in total) by trained clinical nurses in the presence of the children's caregivers. Assessments were conducted by trained and experienced clinical nurses, three times: at baseline,

midline and endline. At the midline of the intervention, a statistically significant difference in intervention effects between the control and intervention groups was observed in language and social-emotional outcomes. At the endline, statistically significant intervention effects were observed for language, social-emotional and personal-social outcomes; and the intervention effects varied from medium to large, implying the clinical relevance of the results. In addition, boys benefited more from the intervention than girls.

Note that the data of a third (exploratory) paper (not included in this thesis, but published in the Journal of Child and Family Studies with the title of "Development, social-emotional behavior and resilience of orphaned children in a family-oriented setting") [157] have been used for power analysis and sample size calculations for the two studies in this thesis.

Chapter 3 generally discusses and reflects on major findings of the two papers. It also presents the conclusion, strengths, limitations, implications and future perspectives. A Dutch summary of the dissertation is presented under chapter 4.

CHAPTER 2: STUDIES AND RESULTS

STUDY 1: The relationship of undernutrition/psychosocial factors & developmental outcomes of children in extreme poverty

Adapted from: Berhanu Nigussie Worku, Teklu Gemechu Abessa, Mekitie Wondafrash, Marleen Vanvuchelen, Liesbeth Bruckers, Patrick Kolsteren and Marita Granitzer.

Published in BMC Pediatrics, 2018; 18(45).

2.1.1. Abstract

Background: Extreme poverty is severe deprivation of basic needs and services. Children living in extreme poverty may lack adequate parental care and face increased developmental and health risks. However, there is a paucity of literature on the combined influences of undernutrition and psychosocial factors (such as limited play materials, playground, playtime, interactions of children with their peers and mother-child interaction) on children's developmental outcomes. The main objective of this study was, therefore, to ascertain the association of developmental outcomes and psychosocial factors after controlling nutritional indices.

Methods: A community-based cross-sectional study design was used to compare the developmental outcomes of extremely poor children (N = 819: 420 girls and 399 boys) younger than five years versus age-matched reference children (N = 819: 414 girls and 405 boys) in South-West Ethiopia. Using Denver II-Jimma, development in personal-social, language, fine and gross motor skills were assessed, and social-emotional skills were evaluated using the Ages and Stages Questionnaires: Social-Emotional (ASQ: SE). Nutritional status was derived from the anthropometric method. Independent samples t-test was used to detect mean differences in developmental outcomes between extremely poor and reference children. Multiple linear regression analysis was employed to identify nutritional and psychosocial factors associated with the developmental scores of children in extreme poverty.

Results: Children in extreme poverty performed worse in all the developmental domains than the reference children. Among the 819 extremely poor children,

325 (39.7%) were stunted, 135 (16.5%) were underweight and 27 (3.3%) were wasted. The results also disclosed that stunting and being underweight were negatively associated with all the developmental skills. After taking into account the effects of stunting and being underweight on the developmental scores, it was observed that limited play activities, limited child-to-child interactions and mother-child relationships were negatively related mainly to gross motor and language performances of children in extreme poverty.

Conclusion: Undernutrition and psychosocial factors were negatively related to the developmental outcomes, independently, of children living in extreme poverty. Intervention, for these children, should integrate home-based play-assisted developmental stimulation and nutritional rehabilitation.

2.1.2. Background

There is little evidence describing extremely poor children's developmental outcomes and, the nutritional and psychosocial factors associated with them. Only few studies have been conducted to investigate the relationship between poverty and undernutrition. For instance, in a multi-national cohort study in Ethiopia, India, Peru and Vietnam, the association between poverty and childhood undernutrition was explored in children between 6 and 17 months of age, and a few years later when these children were between 4.5 and 5.5 years of age [32]. The study revealed that children living in low-resource contexts had significantly increased probabilities of being stunted and underweight in comparison to children residing in more affluent families [32]. Even though this multi-national study considered very important aspects, there were still equally important variables (such as nutritional status, psychosocial conditions and

developmental outcomes) and their interrelations that were left uninvestigated; accordingly, our study focused on these dimensions. Another study conducted on children of 6-59 months of age in North-West Ethiopia showed that higher monthly family income was inversely associated with stunting [158]. A comprehensive review has shown that poverty and food insecurity could detrimentally affect the development of young children aged from birth to three years [31]. For children younger than five living in developing countries, cognitive, motor and social-emotional developmental skills were affected. Early exposure to adversities also compromised their brain development and educational performances [25, 26]. Furthermore, harsh socioeconomic conditions were negatively associated with cognitive performance at five years of age [159]. A study conducted on Zanzibari children of 5-19 months old revealed that stunting negatively affected motor and language development [160]. Reduced stunting, better maternal education and stimulation enhanced growth and intellectual development of children in early ages [161].

Stunting and poor psychosocial stimulation were associated with impaired behavioral development [162]. Furthermore, quality parent-child interaction supported development, particularly language and neurocognitive outcomes, of children in low-income families [163]. Play and quality caregiver-child interaction are important for the social, emotional, cognitive, language and motor development of children beginning in early childhood [75]. Nonetheless, children who live in extreme poverty often fail to enjoy their right to play, which consequently affects their development [75].

Even though these studies are essential, it has not yet been explored whether psychosocial factors, after controlling for undernutrition, further influence the developmental outcomes of children living in extreme poverty. An investigation of the correlations between these factors and the developmental outcomes could be very useful to design early and need-based interventions.

Within this context, the first objective of this study was to determine the nutritional status and psychosocial conditions of Ethiopian children under five living in extreme poverty. The second objective was to compare their developmental performance against age-matched reference peers belonging to families of a middle or higher socio-economic level in Jimma Town. As the third and final objective, after controlling for undernutrition, the relationship between psychosocial conditions and the developmental outcomes of children in extreme poverty was examined.

2.1.3. Methods

2.1.3.1. Study setting

This research was undertaken in Jimma Town, South-West Ethiopia. The population in Jimma Town was estimated to be 198, 228 in 2016 [164]. Diverse ethnic and religious groups live together and though many languages are spoken in the town, Amharic and Afan Oromo are the two dominant ones. Because of its multilingual, multicultural, and divergent socio-economic nature, Jimma town reflects, and is representative of most settings within Ethiopia [150].

2.1.3.2. Study design

A community-based cross-sectional study was conducted from March 1st to September 2nd, 2013.

2.1.3.3. Sampling and study participants

Children in extreme poverty were included in this study if they were (1) between 3 and 61 months of age, (2) living in Jimma Town and (3) living in extreme poverty, as validated by the Office of Women's and Children's Affairs. However, children (1) with observable physical disabilities which hinder the performance of items in Denver II-Jimma, or (2) who were completely blind or deaf, were excluded. The eligibility of these children for the study was evaluated by pediatricians, mental health professionals, special needs experts and psychologists.

Sample size estimation and power analysis: A sample of 672 children per group was required to obtain an 80% power for detection of a difference of 0.07 developmental performance ratio between the extremely poor and reference children when performing a two tailed test at significance level of 0.05. To allow a minimum of 20% dropout, 823 children were recruited per group. For the power calculation, the variance in developmental performance ratio of language domain of 62 children in SOS village-Jimma was used. From these children's data, the standard deviation (SD) of the language performance ratio was 0.13. The sample size calculation was based on the language domain of the Denver-II Jimma because it was the outcome with the largest variability. The children's age ranged from 3.5-72 months (mean=44.6; SD $\pm$ 21.2) [157].

The 823 children were randomly selected from 1,496 children living in extreme poverty. The 1,496 children were selected and registered by Jimma town's Women's and Children Affairs Office. The office selected these extremely poor children using a multidimensional deprivation methodology— severe deprivation of nutrition, safe drinking water, sanitation facilities, health care, housing, access to services and protection from violence— developed by UNICEF [165], and a multidimensional poverty index by Alkire and Santos [166, 167]. Four children were dropped because of incomplete personal data. The remaining 819 children (420 boys and 399 girls) were then enrolled into the study. Among the 819 children, 112 (14%) children were living with foster families. All their caregivers were also requested to provide the necessary information.

The developmental outcomes of these children in extreme poverty were compared to 819 (405 boys and 414 girls) age-matched reference children. They were randomly selected using a lottery method from 1, 597 children assessed for the adaptation and standardization of Denver II [150]. Children in this reference group live with families of a middle or higher socio-economic level and their nutritional status varied between the Z-scores of -2SD and +2SD, implying that they were not malnourished according to WHO Child Growth Standards [168]. Both children in extreme poverty and the reference group lived in Jimma Town.

2.1.3.4. Outcomes, measurements and instruments

In general, developmental performances (personal-social, fine motor, gross motor, language and social-emotional skills) were the primary outcomes.

2.1.3.4.1. Developmental outcomes

The developmental performance of each child was assessed using the Denver-II Jimma [150], a version of the Denver-II [169], adapted to the sociocultural context of children under six living in the Jimma zone of Ethiopia. Denver-II Jimma has an excellent inter-rater and test-retest reliability on the majority of the items in the test [150]. It consists of 125 items: 25 personal-social, 29 fine motor, 39 language, and 32 gross motor. Most of these items require children to perform, and a few are based on their caregivers' report. On average, testing with the Denver-II Jimma took around 20 minutes.

Fig.2.1.1. Developmental assessment of 3 and 2 years old girl and boy, respectively, using Denver-II Jimma

To test the social-emotional development of the children, ASQ: SE questionnaires were used. These are parent-report questionnaires developed to identify children whose social and emotional competences might differ from what is expected [170]. ASQ: SE is recommended for its high rate of detection of social-emotional problems among young children [134]. It has high test-retest reliability [170]. The questionnaires were culturally adapted to the study context and translated into both local languages. An ASQ: SE questionnaire only took about 10-15 minutes to complete for a caregiver.

2.1.3.4.2. Nutritional status

To characterize the nutritional status, anthropometric assessment was done following WHO guidelines [168]. The child's weight was measured using a calibrated electronic weighing scale (SECA Uniscale, Hamburg, Germany). For children under two years, the length was measured using a length-measuring

mat on a flat table (SECA 210, Hamburg, Germany). The height of a child above two years was measured by using a Seca Road Rod 214 portable Stadiometer. Age was recorded from birth certificates or immunization cards. When reliable documents for age estimation were absent, local events calendars were used to help the mother or caregiver estimate the approximate age of the child. The following quality control measures were taken to avoid measurement errors: manual of standard operating procedures was used; standardization exercise was done; equipment calibration (calibration weight) was used before each weight measurement; and close supervisions of the assessments by experts were conducted.

Fig.2.1.2. Clinical nurses taking height/length measurement of a 4-year old girl and 18 months old boy, respectively

2.1.3.4.3. Demographic and psychosocial characteristics

A structured questionnaire was used to collect the demographic and psychosocial characteristics of the participants. Some of the variables measured were maternal age, education and occupation, age, sex and birth order of the child, monthly income of the household, child feeding condition, number of persons living under the same roof with the child, availability of play materials and playground, time spent on play by the child, mother-child interaction, and frequency of a child's interaction with other children.

2.1.3.5. Testing procedure

We obtained ethical approval from The Ethical Review Board of Jimma University, Ethiopia (RPGC/36/2013, dated 13/02/2013). We also obtained written informed consents from the children's parents. Measurements and testing were performed by four trained nurses, who spoke both Afan Oromo and Amharic languages. They were trained for one month by a child development expert and a nutritionist on the theoretical and practical aspects of overall child

development, care, nutrition, anthropometric methods, Denver-II Jimma, the structured questionnaire and ASQ: SE.

The testers assessed children in both groups and the assessments were performed at the children's homes while their caregivers were present. Prior to testing, the tester created a relaxing environment with the child and its respective caregiver. Regarding the assessment order, a questionnaire, together with ASQ: SE, was administered first; the Denver II-Jimma next and finally, the anthropometric measurements. The assessment time for a child took about an hour.

2.1.3.6. Statistical analysis

To guarantee data quality, double data entry was done into EpiData. The data were then exported to SPSS version 22 and analyzed.

The standard score or z-score is the preferred expression for anthropometric indicators in survey. Based on the WHO's Child Growth, internationally representative, standard/reference [168], Z-score is calculated this way:

$$z - score = \frac{\text{Measured value} - \text{median of reference population}}{\text{Standard deviation of the reference population}}$$

Where, median and standard deviation (SD) are from the reference population of WHO.

The anthropometric measures were converted into z-scores of Weight-for-Age (WAZ), Height/Length-for age (HAZ/LAZ), and Weight-for-Height/Length (WHZ/WLZ) using WHO Anthro software [171]. Based on the WHO standard,

underweight, wasting and stunting were defined as WAZ, WHZ/WLZ and HAZ/LAZ below -2SD respectively. The z-scores between -3SD and -2SD represent moderate undernutrition; whereas, the z-scores below -3SD signify severe undernutrition.

The data indicated a prevalence of stunting, wasting and underweight of the children in extreme poverty. To compare the psychosocial conditions of children in extreme poverty and the reference group, chi-square tests (χ^2) were employed. We assumed that there was association between the two categorical variables. Independent samples t-test was used to compare the developmental outcomes of children in extreme poverty and the reference group. The assumptions were checked. To determine the association between the developmental scores and the nutritional/psychosocial indicators, for children in extreme poverty, multiple linear regression analyses were used for each developmental score (personal social, fine motor, language and gross motor) separately. A regression model with the two nutritional indicators (stunting and underweight) as independent variables was fitted. Both nutritional indicators were significantly associated with each developmental score. Next, the demographic and psychosocial factors (child's sex and birth order, maternal age, education, occupation, monthly family income, family size, availability of play materials, availability of playground, play time, child-child interaction and mother-child relationship) were added to the regression model containing the statistically significant nutritional indicators. Finally, a parsimonious model was obtained by means of a stepwise selection. With k independent variables and a slope of each, the multiple regression equation is given as follows:

$$\hat{y} = a + b_1 x_1 + b_2 x_2 + \cdots b_k x_k$$

Where, $\hat{y}$ is what is being predicted; a is the constant or intercept; b_k is the slope or coefficient for x_k; and x_k is the k^{th} independent variable. To check a contribution of each independent variable in the model, the following formula was used.

$$t = \frac{b_k}{SD(b_k)}$$

Where, t is the t-test statistic and $SD(b_k)$ is the standard deviation of the regression coefficient. The p-value for each term tests the null hypothesis that the coefficient is equal to zero (no effect). A low p-value (< 0.05) indicates that the null hypothesis can be rejected, i.e. a predictor that has a low p-value is likely to be a meaningful addition to the model as changes in the predictor's value are related to changes in the response variable. Generally, regression coefficients indicate the mean change in the response variable for one unit of change in the predictor variable while holding other predictors in the model constant. This helps to separate the role of one variable from all of the others in the model.

Because our main objective was to observe the relationship of each independent variable with developmental outcome, we only reported beta coefficents, t and p-value in the result section. From **Appendix A**, the overall F-tests and concrete regression models used can be seen.The significance level was set at 0.05 and all tests were two-sided.

2.1.4. Results

2.1.4.1. Nutritional status and psychosocial characteristics of children in extreme poverty

Regarding the type and degree of undernutrition of children in extreme poverty, 213 (26%), 99 (12.1%) and 19 (2.3%) were moderately stunted, underweight and wasted, respectively; whereas, 112 (13.7%), 36 (4.4%) and 8 (1%) children were severely stunted, underweight and wasted, respectively.

Psychosocial factors such as mother-child interaction, child-child interaction, play time, availability of play materials and playground were very limited for children in extreme poverty, unlike for children in the reference group. Nevertheless, the children spent most of their time playing with whatever was accessible to them, and wherever possible, alone or with their peers. The details are presented in Table 1. Some psychosocial and demographic factors such as maternal age, maternal occupation and education level, family size, income, sex and birth order of the child were not included in Table 1, because they showed less meaningful associations with the developmental outcomes of children in extreme poverty. In particular, the statistically non-significance of maternal education to the developmental outcomes of the children was not expected; we rather expected a strong association with the outcomes because the majority of these mothers in extreme poverty are uneducated and, it is well documented that illiteracy has been significantly related to children's developmental outcomes.

Table 1 Nutritional status and psychosocial factors of extremely poor (n=819) and reference children (n=819)

Variables	Extreme poverty	Reference*	P-value
Nutritional status			
Moderately stunted	213 (26.0%)	-	
Severely stunted	112 (13.7%)	-	
Moderately wasted	19 (3.3%)	-	
Severely wasted	8 (1.0%)	-	
Moderately underweight	99 (12.1%)	-	
Severely underweight	36 (4.4%)	-	
Psychosocial factors			
Child-child interaction (No)	413 (50.4%)	225 (27.5%)	0.001
Mother-child interaction (No)	525 (64.1%)	307 (37.5%)	0.001
Play materials (No)	652 (79.6%)	344 (42.0%)	0.001
Playground (No)	554 (67.6%)	272 (33.2%)	0.001
Play time (No)	193 (23.6%)	135 (16.5%)	0.001
Sex-child (girls)	420 (51.3%)	414 (50.5%)	0.459

Note. P-value = level of significance. Chi-square test statistic was used. *****Children in the *reference group* had the nutritional status between the Z-scores of -2SD and +2SD, indicating they were not malnourished according to the WHO Child Growth Standards.

2.1.4.2. Developmental outcomes of extremely poor and reference children

Children living in extreme poverty performed less well in all the four developmental domains of Denver II- Jimma compared to children from the reference group. They also performed worse on social-emotional skills indicated by the higher scores (Table 2).

Table 2 Developmental outcomes of extremely poor and reference children

Developmental outcomes	**Group**	**Mean(SD)**	P-value
PR Personal-social	Extr. poor	.99(.14)	
	Reference	1.05(.18)	<0.001
PR Fine motor	Extr. poor	1.02(.10)	
	Reference	1.07(.12)	<0.001
PR Language	Extr. poor	.96(.13)	
	Reference	1.03(.14)	<0.001
PR Gross motor	Extr. poor	1.04(.11)	
	Reference	1.07(.10)	<0.001
Social-emotional	Extr. poor	67.87(27.52)	
	Reference	48.68(27.15)	<0.001

Note. PR = Performance Ratio, SD = Standard Deviation,
Extr. = Extremely, P-value = level of significance. We used t-test statistic

2.1.4.3. Developmental outcomes and undernutrition among children in extreme poverty

To test for the statistical significance of the relation between nutritional indices and developmental outcomes, stunting (s) and underweight (uw) were entered into a regression model as binary independent variables.

To personal-social (PS), $\hat{y}_{\mathrm{PS}} = \mathrm{a} + \mathrm{bsxs} + \mathrm{buwxuw}$ both stunting (bs = -.077, t (816) = -2.151, p = 0.032) and underweight (buw = -.152, t (816) = -4.260, p<0.001) were negatively related. To fine motor (FM), $\hat{y}_{FM} = a + bsxs + buwxuw$ stunting (bs = -.123, t(816) = -3.448, p<0.001) and underweight (buw = -.162, t(816) = -4.569, p = 0.006) were negatively associated. To language (LA), $\hat{y}_{LA} = a + bsxs + buwxuw$ stunting (bs = -.178, t(816) = -5.030, p<0.001) and underweight (buw = -.157, t(816) = -4.443, p<0.001) were negatively related. To gross motor (GM), $\hat{y}_{GM} = a + bsxs + buwxuw$ stunting (bs = -.212, t(816) = -6.175, p< 0.001) and underweight (buw = -.283, t(816) = -8.247, p<0.001) were also negatively related. Note that wasting, as an independent variable, was not entered into the regression model because of the small number of wasted children.

2.1.4.4. Developmental outcomes and psychosocial factors among children in extreme poverty

To examine contributions of psychosocial factors, on top of the nutritional indicators, to personal-social, fine motor, language and gross motor development, the psychosocial factors such as limited availability of play materials (pm), limited availability of playground (pg), limited child-child

interaction (cci) and limited mother-child interaction (mci) were added to the regression model containing the nutritional indicators. No additional contribution of psychosocial factors to personal-social development was observed. However, for the remaining three developmental outcomes, some psychosocial factors contributed on top of the nutritional indicators; other socio-demographic variables were adjusted for.

To fine motor development, $\hat{y}_{FM} = a + bsxs + buwxuw + bpgxpg$ limited availability of playground (bpg = -.092, t(815) = -2.682, p = 0.007) was negatively associated; to language development (LA), $\hat{y}_{LA} = a + bsxs + buwxuw + bccixcci + bmcixmci + bpmxpm + bpgxp$ limited child-child interaction (bcci = -.106, t(812) = -3.094, p = 0.002), reduced mother-child interaction (bmci = -.115, t(812) = -3.345, p < 0.001), limited availability of play materials (bpm = -.108, t(812) = -2.982, p = 0.003) and limited availability of playground (bpg = -.098, t(812) = -2.688, p = 0.007) were negatively related; and to gross motor development (GM), $\hat{y}_{GM} = a + bsxs + buwxuw + bccixcci + bmcixmci$ limited child-child interaction (bcci = -.130, t(814) = -3.947, p < 0.001) and limited mother-child interaction (bmci = -.120, t(814) = -3.649, p < 0.001) were negatively related. From these findings, it is clear that the psychosocial factors were negatively related mainly to language and gross motor outcomes.

Based on this parsimonious regression model ($\hat{y} = \mathrm{a} + b_1x_1 + b_2x_2 + \cdots b_kx_k$), the relations of nutritional status and psychosocial factors with developmental outcomes are displayed in Figure 2.1.3.

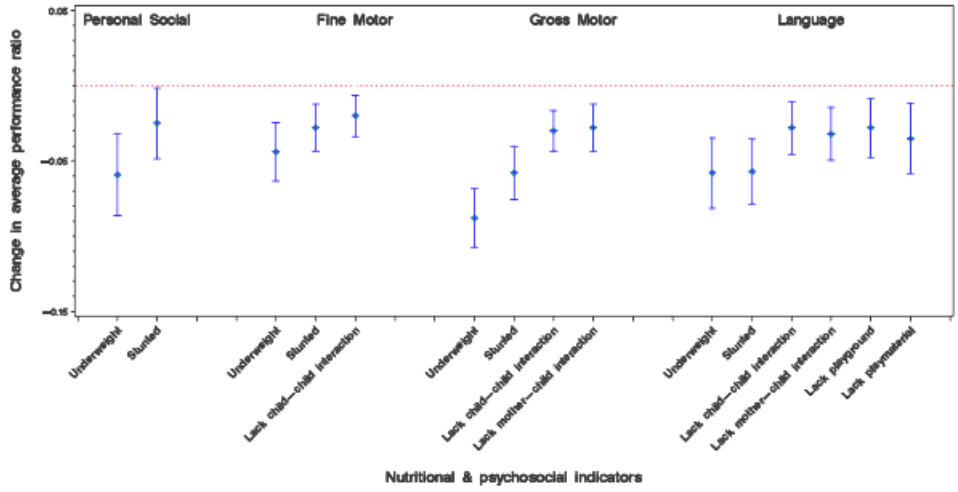


Fig.2.1.3. Relationship between nutritional/psychosocial indicators and developmental outcomes, based on the parsimonious regression model

2.1.5. Discussion

The main objective of this study was to determine the relationship between the developmental outcomes and psychosocial factors after controlling nutritional indices. This study has also described the nutritional status and psychosocial factors of children in extreme poverty. The developmental outcomes of these children were also compared against the reference children.

Within children in extreme poverty, problems of stunting, wasting and being underweight were observed. Chronic undernutrition was the most dominant type. In Ethiopia, children under five residing in extreme poverty had high odds of being stunted [172]. One of the possible explanations could be that stunting, especially in the context of extreme poverty, is cyclical and is highly related to economic capacity. For example, parents who live in an extremely poor environment and had experienced chronic malnutrition themselves during childhood are most likely to have stunted children. If this condition continues, it may create an intergenerational cycle of extreme poverty which is hard to break [162, 173]. Another explanation is that stunting is associated with poor diets of low diversity, poor water supply, poor sanitation and hygiene, and chronic illness [174].

Children in extreme poverty performed more poorly than the reference children in all the developmental domains. A similar performance difference for children ranging from 6-42 months, especially in language, was reported in prior research [175]. One of the reasons is that food insecurity has been indirectly linked to delayed development [31]. Micronutrient deficiencies, food insecurity, infectious disease and parenting stress are factors associated with extreme

poverty, and thus, with developmental delays [176, 177]. Moreover, the differences in the developmental outcomes between the two groups had its origins in adverse early experiences and the socioeconomic inequality of children in extreme poverty [25]. For example, neighborhood economic disadvantage was indirectly associated with child development [178].

Stunting was negatively associated with all four Denver II developmental domains. A previous study conducted in the rural areas of the same region reported that stunting was a risk factor for lower overall developmental scores for children aged 3-24 months [179]. Such an effect on development may be difficult to reverse since, for instance, 11-12 year old children who had recovered from early childhood stunting still showed significantly poorer fine motor skills, even though these children received psychosocial stimulation and nutritional supplementation when they were between the ages of 9 to 24 months [180]. A comprehensive review on studies conducted in low- and middle-income countries has revealed that stunting was associated with delayed development for children less than two years of age, and that the underlying causes of stunting may also have direct effects on cognitive and motor development [181]. The study, conducted in Pakistan, also revealed that stunting was negatively related to gross motor development during infancy [182]. This is because extreme poverty is the major contributor to undernutrition, which becomes a serious hazard to child development [183]. Another explanation is that a lack of nutrients can have long-term effects on the children's brain structure and on their development [184].

Stunted growth during early childhood is associated with poor development of, especially, language and motor skills [185]. This is mainly because it is related to loss of physical growth potential and, reduced neurodevelopmental and cognitive function [36]. In the context of extreme poverty, it is evident that breast-feeding and complementary feeding frequencies are low, dietary diversity is minimal, and infectious disease morbidities are high. These nutrition-related factors had a significant association with child development, particularly motor and language skills [186].

Our study also showed that the children lacked adequate stimulation, mother-child interaction, play materials and playground. This is expected in the context of extremely resource-limited areas such as this study site [75, 163]. Children who live in extreme poverty often face socioeconomic hindrances that hamper their opportunity to interact with the immediate environment [75]. Consequently, these limited interactions may affect their later self-regulation and functional skills [187].

On top of the nutritional problems, psychosocial factors such as limited play activities, mother-child interaction, and child-to-child interaction were negatively associated with the developmental outcomes of children in extreme poverty. Experiencing adverse psychosocial conditions during childhood negatively affects particularly the language development and behavior of the exposed children [188]. The crucial role of, for instance, active and free play for language development was stated previously [75]. Such availability of indoor-outdoor play spaces which engage young children could also facilitate the overall development process [189], not to mention the importance of the language

input by mothers at home for children's language development [190]. Other studies have disclosed that the mother-child relationship was significantly associated with language development [191]. On the contrary, if the relationship is negative: for example, repeated rejection, inconsistency in emotion and carelessness on the part of primary caregiver towards the child, it could be a threat for the child's developmental outcomes [192]. Poor quality of mother-child interaction significantly affected the development of a child in the early years of life [66]. Children experiencing developmental delays were those whose mothers were less responsive and provided less cognitive stimulation [66]. Young children's exposure to a persistently chaotic household was highly associated with poorer language development [193]. This was the case for our study children who were living in extremely low wealth communities. Moreover, in our study, child-to-child interaction or peer relation was significantly related to gross motor development. This finding is consistent with the study that revealed gross motor skills of children to be related to their peer relation [194]. This is because children mostly interact through different play activities that may involve large muscles. In the context of extreme poverty, these activities are limited.

In this study, variables such as household income, family size, maternal occupation and maternal education were not significantly associated with any of the developmental domains. Among several possible explanations, one is the homogeneous nature of the target population in terms of the aforementioned variables. The majority of the families lived in poorly constructed houses with no pipe water, electricity, or a television or radio receiver. They depended on scant income, which could not adequately feed their large family size. Some of the

mothers did small things such as selling seasonal vegetables and fruits on the street and fed their families with the extra money they earned; the rest were housemaids. The families shared a similar context and the differences in the variables were not large enough to explain the variations in the developmental outcomes.

This study is not without limitations. Denver II-Jimma is a screening test and may share the limitations, for example limited specificity, of Denver II [195]. To exclude children from the present study, the experts did not use standardized tools. As a result, there might be a number of children with problems that were not excluded. Some factors, which could be associated with developmental and nutritional outcomes of the children, were not included in this study. These factors include paternal education, age of initiation of complementary feeding, family planning methods used, poor child feeding patterns and breast-feeding practices. However, these factors were well addressed in a previous study in similar region [196].

For future research, it would be interesting to link the problems in developmental performance due to malnutrition to the status of a child's brain by functional MRI (Magnetic Resonance Imaging). Nutritional deficiencies have been shown to be associated with neurological changes [197].

2.1.5.1. Conclusion

Undernutrition was negatively associated with all the developmental performances of the children in extreme poverty. In addition, psychosocial factors such as reduced play activities, child-child interaction and mother-child relationship were negatively related to, in particular, the gross motor and

language development of these children. Because this cross-sectional study was limited only to Jimma Town, we recommend for larger-scale studies in the future. Interventions ought to consider integrated home-based play-assisted developmental stimulation and nutritional rehabilitation, following the multidimensional approach of WHO's ICF.

STUDY 2: Effects of home-based play-assisted stimulation on developmental performances of children living in extreme poverty

Adapted from: Berhanu Nigussie Worku, Teklu Gemechu Abessa, Mekitie Wondafrash, Johan Lemmens, Jan Valy, Liesbeth Bruckers, Patrick Kolsteren and Marita Granitzer:

Published in BMC Pediatrics, 2018; 18(29).

2.2.1. Abstract

Background: Children living with foster families in a resource-limited setting such as Ethiopia are at risk of developmental problems. It is not yet clear whether intensive home-based developmental stimulation assisted by play can reduce these problems. The main objective of this study was to examine the effects of play-assisted intervention integrated into basic services on the developmental performance of children living with foster families in extreme poverty.

Methods: A randomized single-blind (investigator) controlled trial design was used. The study was conducted in Jimma, South West Ethiopia. Using computer-generated codes, eligible children of 3-59 months in age were randomly allocated to intervention (n=39) and control (n=39) groups at a 1:1 ratio. Children in the intervention group received home-based play-assisted stimulation in addition to the basic services provided to children in both groups. The intervention consisted of an hour of play stimulation conducted during a weekly home visit over the course of six months. Personal-social, language, fine and gross motor outcomes were assessed using Denver II-Jimma, and social-emotional outcome was obtained using an adapted Ages and Stages Questionnaire: Social-Emotional (ASQ: SE). Data on sociodemographic characteristics was collected using a structured questionnaire. Anthropometric methods were used to determine nutritional status. The effects of the intervention on the abovementioned outcomes over the study period and group differences in change over time were examined using Generalized Estimating Equations (GEE).

Results: Statistically significant intervention effects were found for language (P=0.0014, effect size (es) = 0.55), personal-social (P=0.0087, es = 0.56) and social-emotional (P<0.0001, es = -1.28) performances at six-month (endline). At three-month (midline) of the study, language (P=0.0151, effect size (es) = 0.34)) and social-emotional (P<0.0001, es = -0.603) benefits from the play-assisted stimulation had already been observed for the children in the intervention group. For language, the intervention effect depended on the child's sex (P=0.0100) and for personal-social performance, on family income (P=0.0300).

Conclusions: Home-based play-assisted stimulation, integrated into the basic services, which targeted both the children and the environment in which they live helped to reduce the developmental problems of children in foster families in the context of extreme poverty. Longer follow-up may reveal further improvements in the developmental performance of the children.

2.2.2 Background

There is growing evidence that early interventions can prevent developmental loss [27]. For instance, a study comprising more than 127,000 families in 28 developing countries [198] have confirmed an improvement of cognitive and social-emotional development in children under five through enriching caregiving practices. Responsive stimulation delivered at home improved child development and care even after the intervention ended [128, 199]. Such interventions are effective, especially, when they are of higher quality, greater intensity, longer duration, organized at home, and involve the parents [114, 200-202]. The best results are obtained when families have opportunities to practice and receive

feedback on the interactions with their children from trained childcare workers [25, 27, 203-206]. Furthermore, home-based stimulation, particularly when mediated by the mothers, shows a sustained positive influence on children's school attainment, academic performances, vocabulary scores, attitudes towards school and improved social adjustment [205].

In a cluster randomized controlled trial in Colombia, psychosocial stimulation provided at home with play demonstrations on a weekly basis to children aged 12-24 months assisted the improvement of their cognitive and receptive language [201]. Home-based early child development intervention also contributed to the improvement of the developmental outcomes of Peruvian children of 6-35 months in age [207]. The 20 years Jamaican follow-up study revealed that, in disadvantaged settings, simple and very early psychosocial stimulation during childhood can have a substantial effect on labor market outcomes and can help to reduce inequality later in life [200]. The returns of early interventions for young children are high during their adult life. Failure to invest early can lead to irreversible damage to children [208].

Early childhood interventions conducted so far have revealed important pieces of evidence. However, studies into the effects of play-assisted stimulation on the overall development of children living with foster families in extreme poverty have not been carried out to the best of our knowledge.

In 2013, we assessed the developmental and nutritional status of 819 children under five years old in extreme poverty [209], and 62 children under six years old in the SOS village in the vicinity of Jimma (Ethiopia) [157]. Children in both groups showed developmental problems, particularly in social-

emotional and language skills; about 40% of these children were also stunted. If the poorest and most marginalized children and families are supported early in life with appropriate interventions, the cycle of poverty may be interrupted; sustainable development may be ensured, and child developmental outcomes may be improved [129, 200, 208, 210-212]. If the interventions receive recognition as core strategies for poverty reduction and high returns, using these contributions as inputs to global policy priorities, better outcomes can be achieved [26, 200, 212-215].

With this background, the main objective of this study was to investigate the effect of a home-based play-assisted stimulation integrated into the basic services (a family home, food, clothing, health care, protection and education), provided by SOS village, on the developmental performances of children living with foster families in extreme poverty. The basic services were given to both groups, whereas play-assisted stimulation was not given to the control group. Provision of the basic services and stimulation started simultaneously.

Play-assisted stimulation refers to play activities and games for developmental stimulation of children in the intervention group. Clinical nurses (trained as play leaders) taught foster mothers parenting skills, how to interact and play with their children. For each child, the nurses applied these skills for six months, focusing particularly on social-emotional and language development of the children. For the stimulation, they used age- and culture-appropriate play materials and games. The weekly play sessions emphasized improving child-mother interactions and transferring key play skills to sustain these skills. It was

hypothesized that play-assisted stimulation, attuned to the basic services, would improve the developmental skills of children in the intervention group.

Detailed information about this topic is presented under "design and intervention". Each child was assessed three times during the study period: at baseline, midline and endline.

2.2.3. Methods

2.2.3.1. Study setting and participants

This study was conducted in Jimma Town, South West Ethiopia, with an estimated population of 198, 228 [164]. Amharic and Afan Oromo languages are predominantly spoken in the area.

Participants of the study were children in a foster care program in this extremely poor community, arranged by SOS Children's Village, and Women's and Children's Office. When the village's capacity to accommodate the incoming extremely poor children was limited, the foster care program was opened as an alternative child care in October 2015. Based on their willingness and capabilities, the foster mothers were selected by the Women's and Children's Affairs Office and SOS Village from among local residents. Children were eligible for the study if they lived in Jimma Town, were selected for the foster care program, and their ages were between 3 and 59 months. Only one child from one foster family was included in the study. Children were excluded if they were completely blind or deaf or both, lived outside Jimma Town, or had profound intellectual disabilities. This study started in October 2015 and was completed in July 2016.

2.2.3.2. Sample size estimation

A total of 78 children were randomized to the intervention (n=39) and the control (n=39) groups. This sample size was needed to obtain 80% power for detection of a difference of 0.09 (SD= 0.13) in language developmental performance ratio between the two groups. Calculation to power the study was based on the estimates of the variance in language developmental performance ratio of 62 children (32 boys and 30 girls) in the SOS Village of Jimma. Their age ranged from 3.5 to 71.8 months [44.6 (21.3) months] [157]. We used the data of SOS children for the power calculation because they had similar characteristics to the children in this study. A 95% level of confidence and two-tailed test was used. This sample size estimate also considered 20% attrition. The formula for the estimation of sample size and power for comparing two means is given hereunder [216]:

$$n = \frac{2\sigma^2 \left(Z_{1-\alpha} + Z_{1-\beta}\right)^2}{\Delta^2}$$

Where, σ^2 is variance; 1-α is level of confidence; $1 - \beta$ is statistical power; Δ is change (or difference in developmental performance between the two groups). The calculation is shown below:

$$n = \frac{2(0.13)^2 (1.96 + .84)^2}{(0.09)^2} = 32.72 \approx 33$$

2.2.3.3. Design and intervention

A randomized single blind controlled trial (parallel) design was used. The random assignment of the children to intervention and control groups was accomplished using computer-generated codes at a 1:1 ratio. The enrollment and allocation of participants was done by an experienced assistant study coordinator. The investigator and those assessing the outcomes were blinded to group assignment. Children in the intervention group received home-based play-assisted stimulation in addition to the basic services provided to children in both groups.

The stimulation activities were carried out by experienced clinical nurses at the children's home, in cooperation with the foster mothers and other children at home or in the neighborhood. The nurses were intensively trained for more than a month on child development, safety and care. They were also trained on key play principles such as safety, enjoyment and stimulation [217], and effective communication with children and mothers in the context of extreme poverty. Immediately after finishing the theoretical training, they practiced what they had learned theoretically. For example, they exercised how to establish good relationship with children and caregivers, effectively interview caregivers, share psychoeducational information, handle children in foster families and how to interactively play with children. They did this in a similar setting in the neighborhood of study site. During all their practical sessions, they were strictly supervised and given feedback to help them master the skills required for the actual intervention works.

The intervention was given during a weekly home visit for 6 months. At every visit, play materials were brought to the home and left for the mother and the child to use. The intervention focused on activities to promote developmental skills and emphasized direct mother-child interactions. Mothers were regularly reminded and motivated to continue practicing the activities and cultural games learned during the home visits.

Fortunately, no visit was cancelled or missed and each intervention child received 24 stimulation sessions in the six months intervention period. The play materials used to assist the developmental stimulation included culturally appropriate and child friendly dolls, toys, puppets, picture books, card games, cognitive games, drawings, color pencils and papers, simple and playful musical instruments, bells, balls and blocks. Cultural play and games were also used based on the age level of a child. During every home visit, the nurses played with the children (including mothers), progressively trained the mothers, and transferred play skills. These approaches had worked well in previous studies [200, 201, 218, 219]. One home visit session took 60 minutes on average and the intervention study lasted for six months.

Fig.2.2.1. Clinical nurses and caregivers stimulating a 42-month and 26-month old girls at home

2.2.3.4. Outcomes, measurements and instruments

2.2.3.4.1 Developmental performance

Personal-social, language, fine and gross motor performances of the children were assessed using the culturally adapted and standardized developmental screening tool, the Denver-II Jimma [150]. It has an excellent inter-rater and test-retest reliability [150]**.** The test took 20 minutes on average per child. On the other hand, social-emotional performance (self-regulation, adaptive functioning, affect, compliance, autonomy, interaction with people and communication behaviors) was assessed using the adapted versions of Ages and Stages Questionnaires: Social-Emotional/ASQ:SE[170, 220]. This developmental screening tool was developed to identify children's social and emotional competences [170] and is believed to have a high rate of detection for social-emotional problems among young children [134]. The developmental performances (personal-social, fine motor, gross motor, language, and social-emotional skills) were the primary outcomes.

2.2.3.4.2. Anthropometric assessments

Anthropometric assessments were done following the WHO guideline [168]. The detail precautions taken to prevent measurement errors were described in study 1 under methods section (nutritional status). The anthropometric measures were then converted into z-scores of Weight-for-Age (WAZ), Height/Length-for-age (HAZ/LAZ), and Weight-for-Height/Length (WHZ/WLZ) using WHO Anthro software [171].

2.2.3.4.3. Sociodemographic characteristics

To gather data on the sociodemographic characteristics of the children, their foster mothers and family, a structured questionnaire was used. The variables on which the data were collected were age, sex and birth order of a child, number of peers in the neighbourhood, child-to-child interaction, maternal age, education, occupation, ethnicity and religion, family size and income.

2.2.3.5 Assessment procedure

Study approval was obtained from The Institutional Review Board (IRB) of Jimma University, Ethiopia (Date: 13-02-2013, Number: RPGC/36/2013) and The Ethical Committee or 'Comite voor Medische Ethiek' (CME) of Hasselt University, Belgium (Date: 04-03-2015, Number: CME2015/535). Written informed consents were obtained from the caregivers before the start of the actual study (**Appendices C and D**). The study was conducted in accordance with The Helsinki Declaration on research involving human subjects [221]. This study was registered at ClinicalTrials.gov (Study Identifier: NCT02988180).

The assessments were made by four trained nurses (assessors). Being blind to the group to which the child belonged, the nurses assessed the children in both groups at the children's home. They first administered the structured questionnaire, alongside ASQ: SE; second, the Denver II-Jimma and finally, the anthropometric measurements (weight first, then height/length). The assessment took an hour per child. Each child was assessed three times during the study period: at baseline, midline (at three month) and endline (at six month). Fig. 2.2.3 presents the timelines and the intervention packages.

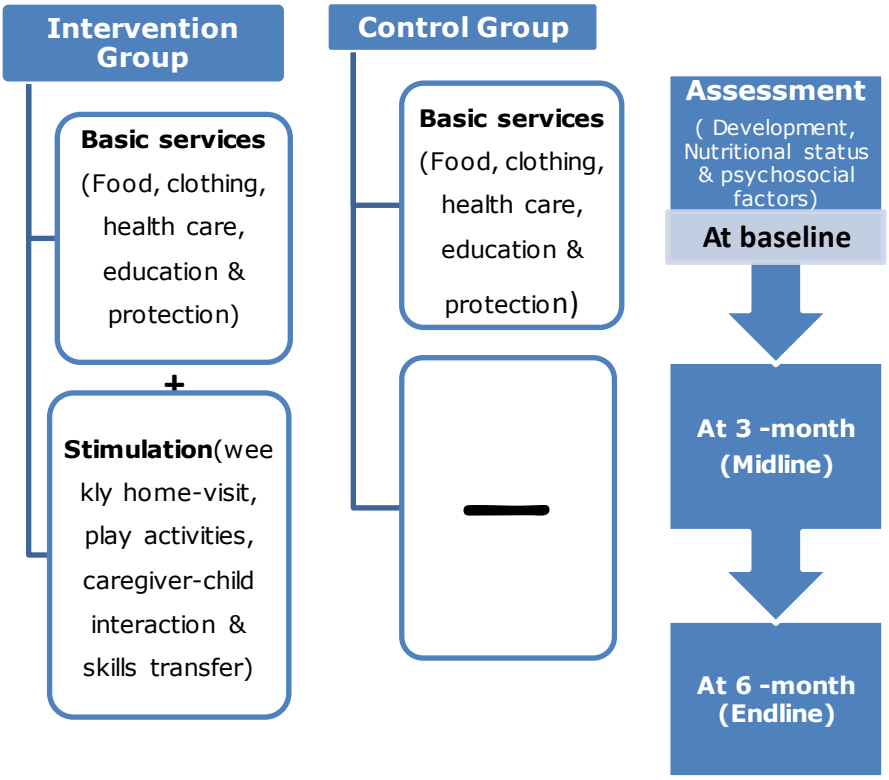


Fig.2.2.2. Intervention packages and assessment timelines for the home-based stimulation

2.2.3.6. Statistical analysis

Double data entry was done into EpiData version 3.1 to ensure data quality [222]. For the statistical analysis, SAS Software version 9.4 was used. To compare the intervention and control group at baseline, chi-square tests (χ^2) were employed for categorical outcomes. Independent samples t-tests were used for data with continuous outcomes. Assumptions for t-test were checked.

The effects of the home-based play-assisted stimulation on the evolution of a child's developmental performances was investigated by using generalized estimating equations (GEE) for repeated data. The number of successfully passed test items was used as the developmental performances. The evolution over time for each developmental performance score was separately modelled by means of a GEE model. The GEE model takes into account that a child's performance scores over time are not independent observations. That is, it takes into consideration the dependency of observations by specifying a working correlation structure. The association pattern within the subject must be considered in the analysis [223]. Analysis of residuals showed a symmetric distribution. The GEE model incorporated two main effects—i.e. an indicator for home-based developmental stimulation and the time in the study (with three levels [baseline, midline (at 3 month) and endline (at 6 month)]—and their interaction term. The interaction term in the model allows for group-specific evolutions in developmental outcome. An unstructured working correlation matrix was specified for each developmental outcome in this study. The GEE model equation used is the following:

$$g(E[Yij|xij]) = \acute{x}i\beta$$

With $\beta = \begin{pmatrix} \beta_0 \\ \vdots \\ \beta_{p-1} \end{pmatrix}$ and $X_i = \begin{pmatrix} 1 \\ X_{i1} \\ \vdots \\ X_{i,p-1} \end{pmatrix}$

where, Yi = (Yi1,Yi2,Yi3), ni = 3; Xij is the j-th covariate value for subject i; g (.) is the link function; the identity link function g(a)=a is used here since the response variable is modelled as a continuous score with a Gaussian conditional

distribution. The generalized estimating equations (GEE) approach of Zeger and Liang enables analysis of data collected in longitudinal, repeated measures designs. It estimates more efficient and unbiased parameters [224].

Checking the strength of the intervention effect was done using online calculators from Psychometrica [225]. Effect size (ES) measures the strength of the result. It ranges from "no effect" to "large effect". An effect size from 0-0.1 is of no effect, 0.2-0.4 is small effect, 0.5-0.7 is medium effect and above 0.8 is large effect [226, 227].

Intervention effect modifiers were examined to check if the intervention effect depended on the covariates. For this purpose, multiple regression models were fitted [228]. The model included the group indicator, the covariate and the interaction term:

$$\hat{y} = a + b_1 x_1 + b_2 x_2 + b_3 * (x_1 * x_2)$$

Where, $\hat{y}$ is the developmental changes from baseline (difference between baseline and endline); a is the intercept; b_1 is the coefficient for group indicator(x_1); b_2 is the coefficient for a covariate (x_2); b_3 is the coefficient for $x_1 * x_2$ (interaction term). An interaction occurs when the magnitude of the effect of one independent variable on dependent variable (y) varies as a function of a second independent variable.

2.2.4. Results

Initially, 82 children were assessed for eligibility. Four children were then excluded because they did not meet the inclusion criteria. Two children became

sick after they had been screened and two other children permanently moved with their foster families to another place. The remaining 78 children were randomized into intervention and control groups. The intervention children received both the basic services and play-assisted developmental stimulation. Children in the control group received only the basic services. The data of all randomized children in both groups were considered for analyses (Fig.2.2.3). The study was conducted as planned in the original protocol. No harm was inflicted on any of the children in each group as a result of the study.

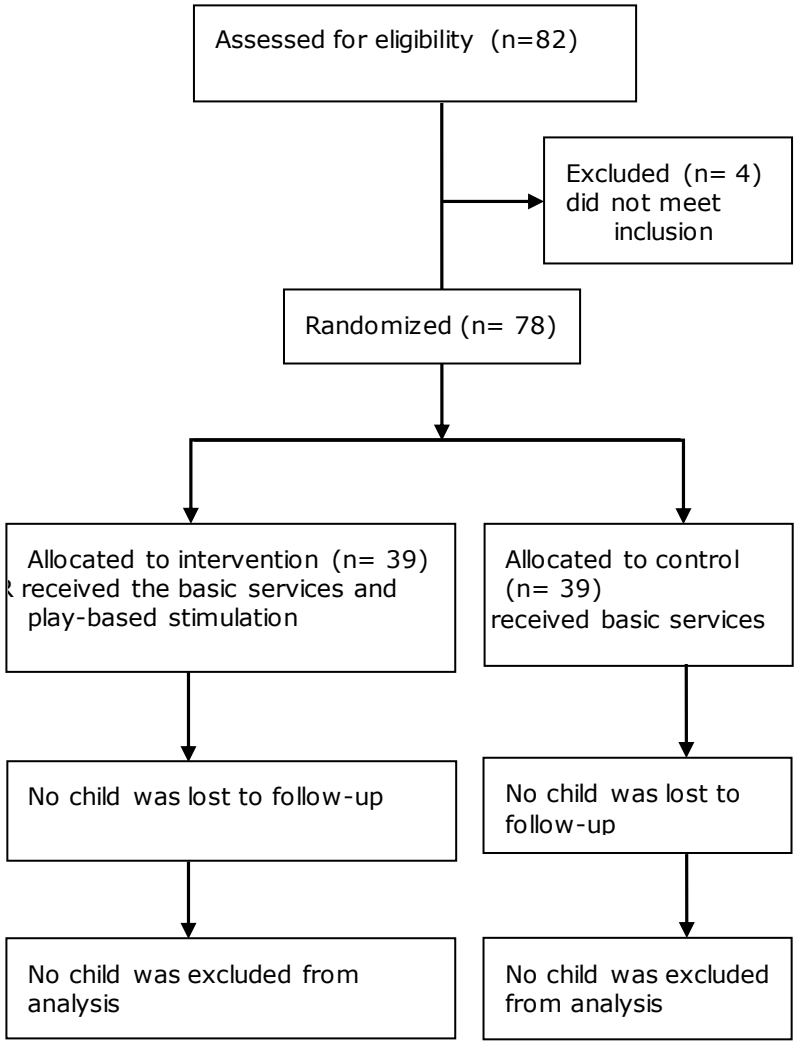


Fig.2.2.3. Flow chart from enrollment to data analysis

2.2.4.1. Baseline characteristics

Baseline child, maternal and family characteristics of the intervention and control group are presented in Table 1. Significant difference was observed in

birth order. Fifty-nine percent of the children in the intervention group were born after a third child compared to 28 percent in the control group.

Table 1 Baseline child, maternal and family variables of the control and intervention groups (N = 78)

Variables	**Intervention** (n=39)	**Control** (n=39)	**Sig.**
Child variables			
Age (in months)	20.83 (14.76)	21.05 (14.77)	0.949
Birth order (born after third child)	23 (59.00%)	11 (28.20%)	0.006
Peers (two or more)	34 (87.20%)	34 (87.20%)	1.000
Girls	14 (35.90%)	22 (56.40%)	0.069
Language performance	17.50 (9.00)	17.90 (8.90)	0.860
Personal-social performance	14.30 (6.30)	14.40 (6.30)	0.929
Fine motor performance	16.90 (6.20)	16.40 (5.60)	0.747
Gross motor performance	18.70 (7.90)	18.80 (7.30)	0.929
Social-emotional performance	49.00 (17.30)	48.60 (24.50)	0.936
WHZ	0.20 (1.40)	-0.10 (1.60)	0.490
HAZ	-1.40 (1.50)	-1.20 (1.50)	0.570
WAZ	-0.60 (1.20)	-0.70 (1.20)	0.782
Maternal variables			
Educ.(Illiterate or≤ grade 8)	28 (71.80%)	32 (82.10%)	0.282
Occup.(house maid or on street merchant)	30 (76.90%)	35 (89.70%)	0.129

Family variables			
Family size (more than 3)	31 (79.50%)	23 (59.00%)	0.050
Family income (< 1.90 USD/day)	30 (76.90%)	36 (92.30%)	0.060

Note. Chi-square test (n (%) and Sig.) and independent samples t-test (mean (SD) and Sig.) were performed for categorical and continuous data respectively

2.2.4.2 Effects of play-assisted stimulation on the developmental performances of children

The observed average changes in developmental outcomes, for the control and the intervention groups, are displayed in **Figures 2.2.4**, **2.2.5**, **2.2.6**, **2.2.7** and **2.2.8**.

The statistical analysis based on Generalized estimating equations (GEE) showed that there was a benefit of the intervention for language (LA) or intervention effect on language (IE_LA), social-emotional (SE) or intervention effect on social-emotional (IE_SE), and personal-social (PS) or intervention effect on personal-social (IE_PS) performances (Table 2). For language performances (at midline: $b_{\_(IE\_LA)} = 1.46$, $Z = 2.43$, $p = 0.0151$, effect size (ES) = 0.34; at endline: $b_{\_(IE\_LA)} = 1.79$, $Z = 3.20$, $p = 0.0014$, ES = 0.55), children in the intervention group had higher average performance scores than children in the control group. Children in the intervention group also performed better in social-emotional outcome (at midline: $b_{\_(IE\_SE)} = -12.73$, $Z = -4.07$, $p < 0.0001$, ES = -0.603; at endline: $b_{\_(IE\_SE)} = -27.06$, $Z = -11.61$, $p < 0.0001$, ES = -1.28). Hence, the benefits of the play-assisted developmental stimulation were already observed after three months for both outcomes. For personal-

social (at endline: $b_{\_(IE\_PS)} = 1.10$, $Z = 2.63$, $p = 0.0087$, ES = 0.56), the beneficial effect of the intervention was significant at endline only (Table 2).

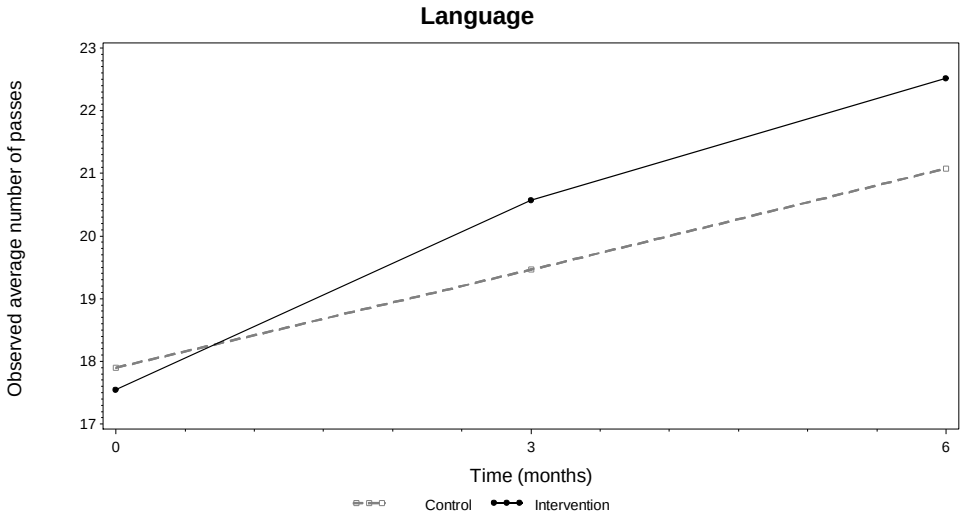


Fig.2.2.4. Language performance of intervention and control (broken line) groups

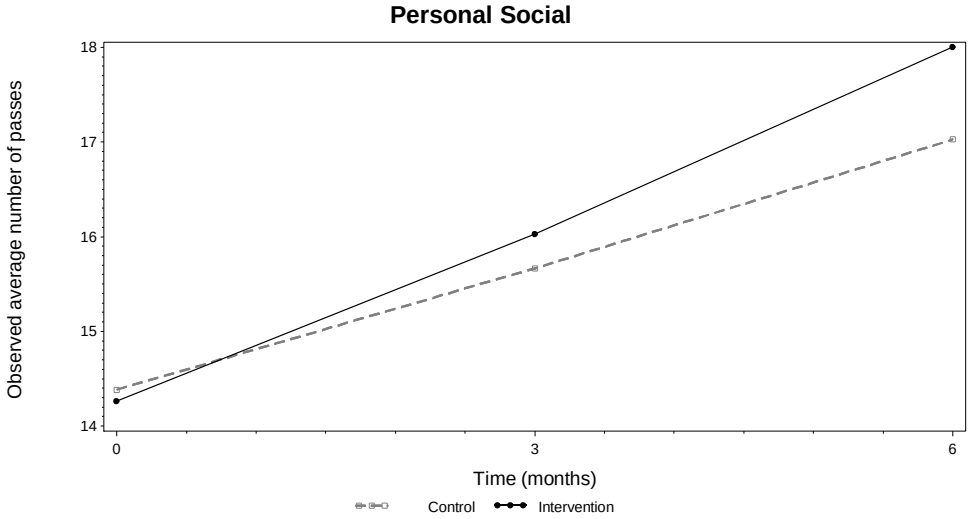


Fig.2.2.5. Personal-social performance of intervention and control (broken line) groups

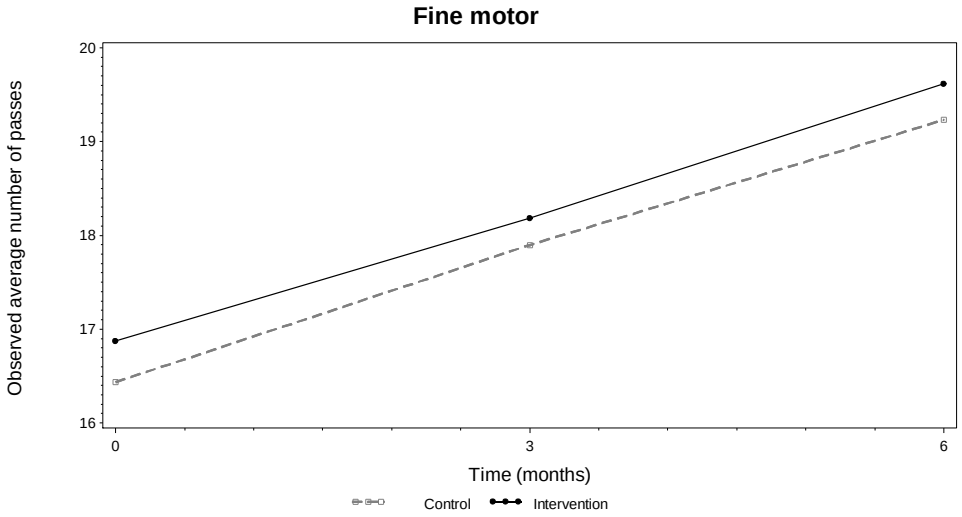


Fig.2.2.6. Fine motor performance of intervention and control (broken line) groups

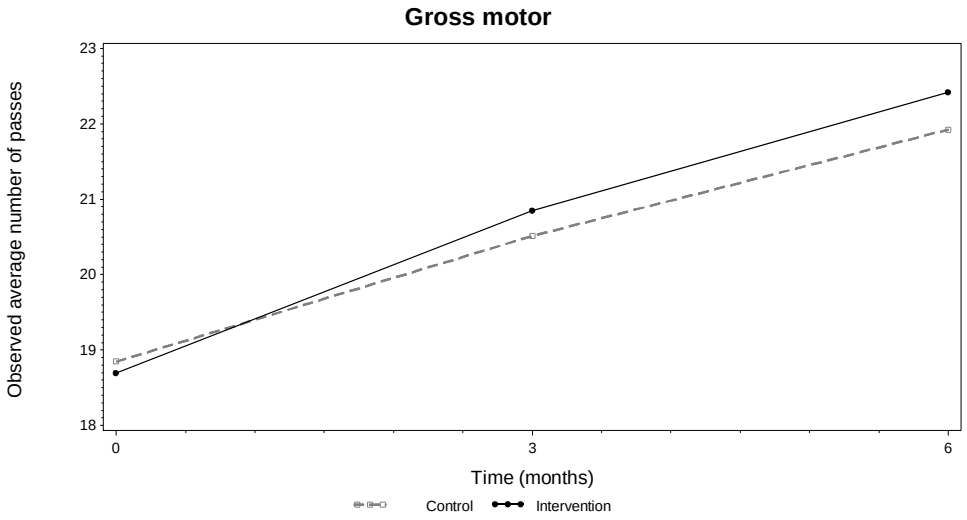


Fig.2.2.7. Gross motor performance of intervention and control (broken line) groups

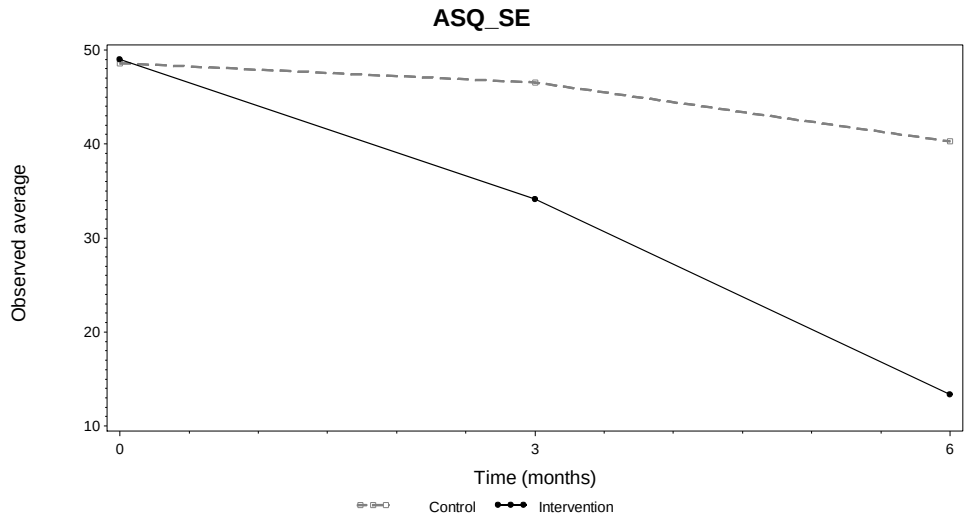


Fig.2.2.8. Social-emotional performance of intervention and control (broken line) groups

Table 2 Intervention effects on the developmental performances of children, using Generalized Estimating Equations (GEE)

	Intervention effect (at 3 months)			Intervention effect (at 6 months)		
Developmental Performances	Estimates (SE)	P-value	ES	Estimates (SE)	P-value	ES
Language	1.46 (0.60)	0.0151	0.34	1.79 (0.56)	0.0014	0.55
Personal-Social	0.49 (0.37)	0.1907	-	1.10 (0.42)	0.0087	0.56
Social-Emotional	-12.73 (3.13)	0.0001	-0.603	-27.06 (2.33)	0.0001	-1.28
Fine Motor	-0.14 (0.40)	0.7177	-	-0.02 (0.45)	0.9562	-
Gross Motor	0.48 (0.57)	0.3938	-	0.63 (0.58)	0.2750	-

Note: Estimates (SE) here are intervention effects or the difference in developmental performance between intervention and control groups at 3 or 6 months. ES effect size, P-value significance level.

2.2.4.3 Dependency of intervention effect on baseline covariates

For the changes in developmental performance (endline versus baseline), we examined the possible effects of baseline variables (child's age, sex, birth order, developmental performance, WHZ, WAZ, HAZ, child-to-child interaction, maternal age and education, family size and income) on the intervention effect. The magnitude of the intervention effect for language depended on the child's sex; for personal-social on family income; for fine motor skills on WHZ, WAZ, child-to-child interaction and maternal education; and for gross motor skills on WAZ and maternal education. For social-emotional performance, no dependency

was observed (Table 3). Regarding language performance, the intervention at endline was more effective for boys than for girls. For personal-social performance, the intervention was more effective for children in the intervention group whose families' monthly income was lower. For fine motor skills, the intervention effect at the endline depended, for example, on limited child-to-child interaction at baseline—i.e children with limited child-to-child interaction at baseline did not benefit from the home-based developmental stimulation at the endline.

Table 3 Dependency of intervention effect on baseline covariates, multiple regression analysis

	Developmental performances									
	LA		**PS**		**SE**		**FM**		**GM**	
Baseline variables	β	P	β	P	β	P	β	P	β	P-value
Child's age	0.01	0.89	-0.03	0.29	-0.35	0.25	-0.02	0.60	0.04	0.38
Birth order	0.02	0.94	-0.04	0.87	1.25	0.56	-0.02	0.92	0.17	0.57
Family size	0.29	0.44	-0.41	0.18	1.87	0.53	-0.19	0.58	-0.40	0.35
Income	0.00	0.84	-0.002	0.03*	0.00	0.99	0.00	0.50	0.00	0.99
WHZ	-0.11	0.78	0.24	0.43	-1.52	0.61	0.99	0.01*	0.65	0.11
WAZ	0.03	0.96	0.65	0.08	1.20	0.75	1.50	0.01*	1.33	0.01*
HAZ	0.11	0.78	0.43	0.17	2.81	0.35	0.39	0.25	0.66	0.13
Performance	-0.01	0.84	-0.02	0.74	0.05	0.65	-0.04	0.53	0.08	0.22
Maternal age	0.04	0.61	0.02	0.81	-0.28	0.68	0.06	0.60	-0.01	0.96
Maternal education	-1.07	0.78	-2.87	0.34	-0.67	0.98	-7.40	0.02*	-8.83	0.03*
Child-child interaction	-5.54	0.09	1.08	0.69	5.55	0.83	-7.80	0.01*	-1.71	0.64
Child's sex	3.03	0.01*	0.28	0.76	-2.24	0.81	1.06	0.32	0.18	0.89

Note. β estimate or effect, P (P-value) significance level, LA language, PS personal-social,

SE social-emotional, FM fine motor, GM gross motor, WHZ weight-for-height/length z score, WAZ weight-for-age z score, HAZ height/length-for-age z score. For some variables, the effects (β) are very small as they were used in continuous form.

2.2.5 Discussion

Play-assisted stimulation integrated into basic services and given at home on weekly basis significantly improved the social-emotional, language and personal-social performances of children living with their foster families in the context of extreme poverty. At midline, we detected improvements in social-emotional and language outcomes for the intervention group. For personal-social, significant improvements were observed only at the endline.

Though the intervention effects were not observed as early as in this study, other intervention studies have also confirmed that intensive home visits can improve children's developmental outcomes [200, 201, 207, 219, 229, 230]. Interventions on maternal play and parenting skills have also improved young children's social, emotional, communication, language and cognitive competence besides improving maternal warmth and cognitively responsive behavior [97, 204, 231-234].

The effect sizes for the significant developmental performances in this study range from medium to large [235]. The intervention effect in this study has shown clinical relevance, especially for social-emotional and language performances. For the social-emotional skills, on average, after three months of intensive intervention, about 13 total scores of social-emotional problems were reduced, and after six months, 27 total scores were abridged for the children in the intervention group. For language skills, 1.5 items at three months and 1.8 items at six months were improved. Assuming that these improvement rates will be sustained, because of the skills transferred to and mastered by mothers during the intervention, children in the intervention group may further improve

their social-emotional and language development. At the end of the study, most mothers also pointed out that they had observed encouraging developmental improvements in their children. They also found the play and parenting skills highly relevant to make the observed developmental performance changes sustainable.

There was no significant benefit of the intervention on fine and gross motor performances during the six months follow-up. This may be because the basic services benefited children in both groups in their motor development, and the intervention did not add extra value for children in the intervention group. Another explanation could be that the intervention cannot improve motor development within a period of only six months. Previous studies have also revealed non-significant effects of short-term developmental interventions on motor performance [201, 236, 237]. In a randomized play-based home intervention for under-25 month age children in low socioeconomic families, the effects on motor development were observed more than one-year after the intervention ended [238]. A similar study on children of 24 months in age showed improvement two years after the end of the intervention [128]. Furthermore, a home visiting early child development (ECD) program in the Caribbean significantly improved fine motor skills of birth to 3 year-old children, one year after the implementation of the program [239].

We investigated effects of baseline variables on the magnitude of the intervention effect and observed that families with lower income benefited more from the intervention. Most of the children from lower income families have less infrastructure, interaction time and opportunities for stimulation. As a result,

they may be more delayed developmentally. Because of their lower baseline developmental level, the intervention effect might be more pronounced when they are given additional stimulation compared to those with a better income and a better chance of getting home-based stimulation. Evidence of this kind has already been documented in countries such as Jamaica, Colombia and Peru [200, 201, 207]. What is not yet clear is that the intervention effect on language performance for the boys in the intervention group was higher than that of the girls. This may partly be because of a deep-rooted cultural practice and bias towards being a boy or a girl. In Ethiopia or other African countries, family members (particularly mothers) show more preference to, give attention to, talk to and interact more with boys than girls. This maternal behavior could result in language skill differences between the two sexes, in the context of the study area; and contexts may establish desired gendered outcomes in children [240]. However, it was unexpected that the home-based developmental stimulation at endline did not depend on sex for social-emotional skills. Moreover, no baseline age dependency of intervention effect for any of the developmental outcomes was observed. This implies that both younger and older children benefited from the intervention in the same manner.

This study can be scaled-up in low-resource settings and home environments. It is feasible and cost-effective. For example, the intervention cost per child for six months was only 35 USD. In a home setting, the play activities can easily be integrated into the day-to-day activities of mothers and children. The play materials are also of low cost and locally available. Age-appropriate cultural games can be used effectively. Because both the children

and mothers enjoy the play and interaction sessions, the one-hour weekly home visit is appropriate. Moreover, the skills are easily transferable and sustainable.

The major limitation of this study is its short period of follow-up. The study was planned this way mainly because of financial constraints. Fortunately, it was observed that the houses of families of children in the intervention and control groups were fairly far away from each other, i.e. the possibilities of sharing information and intervention materials were minimal. Nonetheless, there might be accidental contamination. The use of the developmental screening tool, Denver II, could also be a limitation for its limited specificity [195]. However, we adapted and standardized the test and used a continuous scoring system to overcome possible limitations.

If Western developmental assessment tools were used in different cultural contexts such as low-income and middle-income countries without adapting and standardizing, the developmental outcomes would not be valid and dependable [241-243]. In an attempt to minimize most of the limitations, we used culturally appropriate tools. Regarding Denver II-Jimma, among 125 Denver II test items, 55 (20 personal-social, 18 fine-motor, 15 language and 2 gross-motor) were theoretically identified as culture-specific. These 55 items were piloted through exploratory surveys and discussed at a consensus meeting attended by multidisciplinary professionals such as a psychologist, a nutritionist, a pediatrician, a special needs educator, a physiotherapist, occupational therapists and a neuroscientist. Only 36 of them needed adaptation. The other 19 items were retained. Adaptation, re-adaptation and further fine-tuning of Denver II test items resulted in the Denver II-Jimma, which comprises 36

adapted and 89 original Denver II items. Inter-rater reliability of Denver II-Jimma was excellent (kappa > 0.83) for all tested items [150].

2.2.5.1. Conclusion

In conclusion, if a multidimensional home-based play-assisted stimulation— taking into account the contextual factors, activities and participation of the children— is given in a resource-limited context, the benefits for children under five are quick and meaningful, particularly for social-emotional and language skills. The sustainability of the benefits of the family-involving and skill-transferring intervention study can be high. Future research should focus on longer duration of intervention, to observe improvements in all the developmental performances of children.

CHAPTER 3: GENERAL DISCUSSION AND FUTURE PERSPECTIVES

3.1 General discussion

Optimal early childhood development is vital for all children to achieve their full potential, and is the basis for the Sustainable Development Goals (SDGs). Early childhood is a critical period that needs extra care and multi-sectoral support. In reality, many children may not find themselves in such an optimal situation. In this respect, children who live in extreme poverty lack even basic care and services, which might compromise their general health, nutritional status, and overall development. These outcomes and the development of the brain are essentially shaped by the environment in which the children live, in early years of their life. Unless dealt with as soon as possible, the risks these children are exposed to could even be transferred to the next generations. Therefore, effective interventions are imperative to curb such intergenerational influences. However, to design interventions, the exact problems of these children need to be identified and documented. This information was available for children in poverty in United Kingdom, United States, South Asia, Latin America and the Caribbean, but there is little for Sub-Saharan Africa and none for Ethiopia. For children in "extreme" poverty, the availability of such information is even more limited. Further, only few childhood interventions have been conducted on children in poverty, mostly in South Asia and, Latin America, and the Caribbean.

The first focus of this dissertation was thus to document the developmental outcomes, nutritional status, and psychosocial factors of the children, and to analyze how the psychosocial factors/nutritional status interact with their developmental outcomes (Study 1; **Chapter 2**). Based on the children's profile, we conducted a home-based play-assisted developmental

stimulation integrated into the basic services and scrutinized its effect on their development. This was done in collaboration with the primary caregivers of the children. The intervention took into consideration the WHO's ICF multidimensional aspects such as contextual factors (a child and his/her home environment), tasks and children's participation in activities. It is believed that such intervention is cost-effective, easily manageable, and sustainable (Study 2; **Chapter 2**).

3.1.1 Developmental, nutritional and psychosocial profile and their interrelations for children in extreme poverty

Our Ethiopian children under five living in extreme poverty performed worse in all the tested developmental outcomes—language, social-emotional, personal-social, fine and gross motor—than the reference children. This finding somehow confirmed prior results in other countries. For example, a previous study reported that 3 and 4-year old children living in resource-poor settings worldwide experienced low social-emotional and cognitive development [244]. Another study conducted on children under 4 years in the Amazon region of Peru revealed poor performance in motor and language skills [245]. Even in developed countries such as the United Kingdom and the United States, compelling differences in early language development were observed among infants from disadvantaged and advantaged families [246, 247]. The main reasons these previous studies listed were family poverty, stunted growth, limited visits by community health agents, lack of cognitive stimulation, poor parental caregiving practices, limited access to education, lack of sanitation, and access to clean drinking water, as well as diarrhoeal disease

[244, 245, 248, 249]. These aforementioned factors were associated with extreme poverty and negatively affected children's development, and may result in lower academic performance later in their lives [250] and lasting effects on adult human capital [251]. In addition, material hardship such as food insecurity, residential instability, inadequate medical care, and financial troubles were related to problems in child development [252-254]. More importantly, child development in general and brain development in particular are strongly associated with environmental factors [255]. For example, adverse early experiences and environments can damage developing brain architecture and lead to problems in development, learning, behavior, and both physical and mental health**.** Sensory pathways for basic vision and hearing are the first to develop, followed by early language skills and higher cognitive functions. All the above mentioned multifaceted factors can affect the quality of brain development by establishing a fragile foundation for all the developing abilities. They can slow down and alter how neural connections are made in younger children's brains, and can even reduce earnings as an adult by up to 25 percent [256-259].

Undernutrition, especially stunting, was common among our study children; one in three children were stunted. This is a serious problem compared to the global picture of stunting, which affects one-fifth of all children worldwide [260]. Major contributors to child stunting in these countries are known to be extreme poverty, child disease and illness, and socio-cultural barriers [183]. After all, our study children live in households where food insecurity and low diet diversity are pervasive. Food insecurity can influence children's diet diversity, and both can negatively affect the nutritional outcomes of the children [261-

264]. Most mothers in impoverished settings live in households with extremely poor wealth status and are uneducated. Low maternal education and socio-economic status are related to each other and may contribute to stunting [265]. Further, stunting was negatively related to language, motor and personal-social skills of children under five in extreme poverty in this study. A study conducted in Burkina Faso, Ghana and Malawi also reported that stunting was associated with poor language and motor skills for children below 18 months [185], but gave no information about the relationship between stunting and personal-social skills. These problems may also result in substantial long-term impairments of cognitive functioning [266, 267]. Stunting is one of the crucial factors in resource-limited settings, and has far-reaching implications for child development and human capital formation [268].

Our Ethiopian children also experienced adverse psychosocial conditions such as inadequate stimulation at home, low quality caregiver-child and child-child interactions, limited play time, access to play materials and playgrounds. These psychosocial difficulties were negatively related mainly to the language and gross motor skills of the children. The disadvantaged context of poor housing quality and material and financial resources might have negatively contributed to the outcomes [269]. Further, the caregivers of our study children predominantly look for work such as housemaids, selling seasonal fruits and vegetables on the street, and daily labor to feed their children. They are always stressed and do not have the time and mindset to adequately interact with their children or stimulate them. They also don't have time to prepare play material for their children or visit a playground to help the children play and interact with their peers. Their hurried lifestyle can reduce children's play time and

interactions [270]. Further, cultural traditions and beliefs that somewhat discourage parents from verbally engaging with children may contribute to the restricted interactions and scaffolding [271]. Conversely, it is well-documented that parental playfulness has an important role in parent-child interaction and children's outcomes [272, 273]. All these psychosocial disruptions appeared to influence the developmental outcomes of the children. For instance, the children's lack of play materials, peer collaboration, and interactions influence their gross motor, language and cognitive development [274-276]. Unexpectedly, the psychosocial factors did not significantly associate to personal-social and fine motor skills in this study. In previous studies, the same findings, in which psychosocial conditions related to language and gross motor but not to personal-social and fine motor skills, were reported [274, 276]. Particularly, it was surprising that the psychosocial factors (such as caregiver-child and child-to-child interactions) did not relate to personal-social because the "social" aspect of personal-social domain is about interacting with people. This may be related to the collective cultural practices in Ethiopia, like in most African countries, that give less attention to children and interaction with them—for example, the believe that children's play and interactions are waste of time.

As is the case with extreme poverty, the consequences of stunting and psychosocial adversities are transgenerational and have negative effects at the individual, community and national level in the short- and long-term [277, 278]. For example, children who grow up in extreme poverty are eight times more likely to live in poverty during their adult years [279]. Likewise, the impact of stunting on development continues in the subsequent generation of children. Children from stunted parents will have lower cognition, educational

achievement, income, and economic productivity when they become adults [280]. Also, caregivers' hostile childhood experiences are significantly associated with their children's developmental risk [173, 281]. A reduction in poverty, socioeconomic inequality, chronic undernutrition, and psychosocial difficulties for only one generation may not result in a substantial decrease of the problems in the next generation. To curb these problems across the generations, such efforts need to be sustained over decades [282]. Public investments in children's health, nutrition, psychosocial wellbeing, and development can break the intergenerational transmission of the problems to later generations, particularly in less developed nations [279], because the lower the socioeconomic status, the worse the situation, and the quicker the recovery if intervened well [283]. Reducing such gaps also requires that governments build systems that allow a healthy standard of living [283]. For instance, introducing home-based early intervention for children living in disadvantaged neighbourhoods has the potential to break the cycle of the negative impact of poverty, stress on parenting, poor health, and low educational performance. This will improve child development and in turn, population health [284]. Focusing on parenting outcomes such as parental supportiveness, emotional responsiveness, and cognitive stimulation as mechanisms for children's outcomes in home-based programs has been found to be effective [285-287]. As part of a comprehensive global early childhood development (ECD) initiative [288-290], we assessed and documented the developmental, nutritional, and psychosocial profile of children in South West Ethiopia and conducted a home-based play-assisted developmental stimulation trial taking into consideration the demands identified and the needs of the children.

3.1.2 Effect of home-based play-assisted stimulation on developmental outcomes of children

We found significant intervention effects for the children's language and social-emotional outcomes at the third and sixth month point in the intervention, and for personal-social only at sixth months (endline). Effect sizes after sixth months were medium to large (above 0.5), showing the practical relevance of the home-based play-assisted intervention, integrated into the basic services, for the children's developmental skills. Further, caregivers involved in the intervention observed promising developmental and relationship quality improvements in their children, and showed high interest to make these positive changes sustainable. Unlike previous studies, this research already revealed language and social-emotional benefits of the intervention at the third month. In Peru, for example, the home-based early childhood development intervention improved all the developmental domains, including fine and gross motor skills of children aged 6-35 months at the twelfth month, relatively later than ours [207]. In the short time span of only six months, we did not observe improvement of fine and gross motor skills of the intervention children. The children's motor skills may need a relatively longer intervention period to become rehabilitated [128, 238, 239].

During our home-based intervention, clinical nurses trained and transferred parenting and play skills to the primary caregivers for one hour a week. The nurses showed caregivers how to focus on all the children's developmental skills through play and specifically worked on caregiver-child

interaction, using primarily praise. It is believed that these practices benefit both the children and caregivers, and the benefits would be sustained overtime [128, 129, 291, 292]. Previous studies have reported that early childhood development interventions improved caregivers' wellbeing, and their responsive parenting knowledge and skills [97, 293-295]. Further, early childhood stimulation interventions can later benefit young adults. This was evident in Kingston, Jamaica, where children aged 9 to 24 months were involved in a two-year nutritional and psychosocial stimulation study and showed a higher IQ, educational attainment and general knowledge, and fewer symptoms of depression and violent behavior at age 22 [213]. Generally, early childhood is a critical period when the benefits of stimulation interventions are augmented and the negative effects of risk can be reduced. The benefits are life-long, and include improved health, wellbeing, and ability to learn and earn [62]. Such interventions can also contribute to sustainable development for the future generations [296-298].

3.2. Strengths and limitations of this project

3.2.1. Strengths

The profiling of a large sample of children in extreme poverty in study 1, which informed the rigorous design (RCT) of the stimulation intervention (study 2), were the major strengths of the studies documented in this dissertation. The use of multidimensional approach (the WHO's ICF) which was adopted to address the multifaceted problems of the children living in extreme poverty was another quality of the current project. The participation of multidisciplinary team of researchers and the use of socio-culturally relevant developmental assessment

tools were also strengths of this work. The effective collaboration we developed with primary caregivers, the time and resources invested in caregiver-child interaction and the skills transfer training conducted weekly will help the intervention effect to be sustainable—again, this is another achievement of the project.

3.2.2. Limitations

The major limitation of this research project was its short intervention period, only six months. We designed it this way because of shortage of budget. Fortunately, it was observed that the houses of families of children in the intervention and control groups were fairly far from each other, i.e. possibilities of sharing information and intervention materials were minimal. Nonetheless, there might be contamination in ways we do not realize. The power analysis to calculate sample size for the home-based play-assisted stimulation study was based on developmental performance ratio, but later the data analysis depended on developmental performance score; this could be a limitation. It is also considered a limitation of this work that caregiver-child interaction was assessed with only one categorical item. The fact that the studies were confined to one area, Jimma Town, is another limitation because of lack of national representation.

3.3. Conclusion

In Sub-Saharan Africa, especially in Eastern Africa, the number of children under five failing to reach their developmental potential is estimated to be large. In Ethiopia, one of the most resource-poor countries in the world, the estimates

may even be larger because children born in the context extreme poverty are at high risk for developmental and health problems, and are twice as likely to die before the age of five. However, specific developmental problems and context-specific developmental interventions have not yet been documented in the area among children in extreme poverty. This dissertation presents two studies focusing on specific problem identification and intervention for the documented developmental problems. The first study investigated extremely poor children's developmental, nutritional, and psychosocial outcomes, and their interrelations. This study yielded an adequate profile of these children, which helped us to design a randomized controlled trial. The second study examined the effect of home-based play-assisted stimulation, integrated into basic services provided by SOS Village in Jimma and in collaboration with primary caregivers, on the developmental outcomes of foster children under five living in extreme poverty. Foster children belong to the group of children in extreme poverty. This multidimensional intervention packages adopted the WHO's ICF framework. The developmental outcomes were assessed by using socio-culturally adapted tools. It was observed that this multidimensional developmental stimulation intervention significantly benefited these children, in language, social-emotional and personal-social outcomes. The study benefited all children (younger and older) under five in the same manner, but benefited boys in language skills more that girls. This study reveals the relevance of home-based stimulation, embedded in another family-centered program, which focused on caregivers' cooperation and contextual factors, activities, and participation of the children and caregivers.

3.4. Future perspectives

3.4.1. Recommendations for implementation and policy

The home-based play-assisted developmental stimulation intervention in this project can benefit children in need at preschools, orphanages, refugees' camps, with foster and adoptive parents, and in other similar settings. Enhanced support for such disadvantaged children is essential to improve development, nutritional status, health, human capital, and wellbeing across the course of their life [299]. Building intervention packages on existing delivery platforms is preferable for the feasibility of scale-up [300]. Our developmental stimulation package was integrated into basic services. The responsive parenting and play skills we employed seem easily transferable and sustainable. This conclusion was deduced from the results we obtained from the interviews with the caregivers towards the end of the developmental stimulation study. We utilized locally available and minimal resources. For example, the costs of the home-based play-assisted stimulation intervention study were approximately US$ 5 per month per child; the estimation was based on the play materials used, intervention workers' salaries and other related expenses. The costs can even be reduced if non-professional trained intervention workers and assessors are used instead of clinical nurses [204]. In addition, the developmental and anthropometric assessment tools can easily be used after short training, and assessments take only about an hour. Accordingly, integrating the assessments and the intervention to existing services, such as primary health care, kindergarten, early primary education and childcare centers is of paramount importance [301]. However, this requires tireless work to advance political

priority for early childhood development interventions in resource-poor countries such as Ethiopia [302]. In Ethiopia, although Early Childhood Care and Education Policy framework and multi-sectoral implementation strategies were developed in 2010, the changes on the ground are still not impressive.

To make the implementation of this home-based play-assisted stimulation intervention more practical, plans need to be crafted to work with the Ministry of Health (MoH) in Ethiopia to integrate the intervention package into Health Extension Program (HEP). The HEP is a government-led community health service delivery program designed to improve access to and utilization of preventive, wellness, and basic curative services. The program focuses on hygiene and environmental sanitation, disease prevention and control, and family health services and, provides 17 different packages. Developmental stimulation has not yet been included as an intervention package; in the future, while revising the program, it will be worth considering the inclusion of the stimulation component. The program is currently being carried out by front-line community health workers or Health Extension Workers (HEWs). They are all female, 10^{th} grade high school graduates recruited from the community and trained for one full year. They are then deployed back into the community to promote health and provide services at a household level. They are posted to rural communities across Ethiopia, and much of their time is devoted to home visits and outreach [303-305].

Further, we have already started working with the Ministry of Education (MoE) to open study programs in early childhood development interventions and integrate the intervention packages into preschool curriculum. For example,

curricula for Bachelor and Master's degree programs have been developed, and center of excellence is planned to be established in Jimma University, Ethiopia, as the result of a previous PhD project on SAM children (by Dr. Teklu Gemechu Abessa) and this PhD project. In addition, community ownership of the intervention package is key to a sustainable impact. The knowledge and skills will be transferred to communities and households through direct training, cultural coffee ceremonies, media outlets and community-based organizations such as 'Edir', 'Equb' and 'Mahebar'.

The findings from this work can be used to formulate policy of comprehensive childhood development and stimulation, particularly taking into account the most marginalized children. These findings can have implications, not only in Ethiopia but also in other low and middle income countries across the globe; for example, in achieving one of the developmental indicators of the Sustainable Development Goals: meeting developmental milestones (indicator 4.2.1) for children younger than five years [306]. Evidently, optimal early child development lays the foundation for subsequent academic and social performance, economic productivity, reduction in violent behaviour and societal contributions [307, 308]. The Early Childhood Care and Education Policy framework and multi-sectoral implementation strategies developed in 2010 in Ethiopia overlooked these important aspects: early child development and developmental stimulation. Future incorporation of them will make the policy and the strategies complete and helpful because there has been strong evidence that lack of developmental stimulation is highly associated with low developmental outcomes [244, 309]. The findings can also serve as evidence-based inputs for curricula development and revisions of holistic child

development, nursing, paediatrics and preschool education in Ethiopia. Overall, the findings from this PhD project may inform policies, enhance both the generation of new research in related and untouched areas and, the application of progressive knowledge to make a difference in the lives of socio-economically challenged children and families [310].

3.4.2. Recommendations for future research

The six months' stimulation intervention in the present work might not be adequate to improve development in some domains, such as fine and gross motor skills. Accordingly, the children participated in the current stimulation intervention need to be followed up to evaluate long-term effects of this intervention on their developmental skills (personal-social, language, social-emotional, fine motor, gross motor and intellectual performance), behavior and educational attainment. Because the present work was limited in one-hand to one study site, and in another hand to short intervention period, a multi-sectoral and multidimensional family-centered developmental intervention on a larger scale and with a longer follow-up period is suggested for further studies, while including sub-groups of children in different contexts such as in refugees' camps, orphanages, childcare centers and many more. To achieve this goal, collaborating with relevant stakeholders such as MoH, MoE, the Ministry of Women and Children's Affairs (MoWCA), SOS Villages-Ethiopia, UNICEF-Ethiopia and Save the Children will be vital.

REFERENCES

1. United Nations: **The Sustainable Development Goals Report** In. New York; 2017.
2. WHO: **World Health Statistics 2016: monitoring health for the SDGs, sustainable development goals**. In. Geneva; 2016.
3. Le Blanc D: **Towards Integration at Last? The Sustainable Development Goals as a Network of Targets**. *Sustainable Development* 2015, **23**(3):176-187.
4. Buse K, Hawkes S: **Health in the sustainable development goals: ready for a paradigm shift?** *Globalization and health* 2015, **11**:13.
5. WHO: **Promoting health in the SDGs. Report on the 9th Global conference for health promotion, Shanghai, China, 21–24 November 2016: all for health, health for all**. In. Geneva: World Health Organization; 2017.
6. WHO: **Health in 2015: from MDGs, Millennium Development Goals to SDGs, Sustainable Development Goals.** In.; 2015.
7. Lucas JE, Richter LM, Daelmans B: **Care for Child Development: an intervention in support of responsive caregiving and early child development**. *Child: Care, Health and Development* 2017, **44**:41--49.
8. Nilsson M, Griggs D, Visbeck M: **Map the interactions between Sustainable Development Goals**. *Nature* 2016, **534**.
9. Watkins K, Quattri M: **Child poverty, inequality and demography: Why Sub-Saharan Africa matters for the Sustainable Development Goals**. In. London: Overseas Development Institute; 2016.
10. UNICEF-Uganda: **Situation analysis of child poverty and deprivation in Uganda**. In.; 2014.
11. Roser M, Ortiz-Ospina E: **Global Extreme Poverty. Published online at OurWorldInData.org. Retrieved from:**

'https://ourworldindata.org/extreme-poverty' [Online Resource]. 2018.

12. Bird K: **The Intergenerational Transmission of Poverty: An Overview. In: Shepherd A., Brunt J. (eds) Chronic Poverty. Rethinking International Development Series**. In. London: Palgrave Macmillan; 2013.

13. Shepherd A, Scott L, Chiara Mariotti, Kessy F, Gaiha R, Lucia da Corta, Hanifnia K, Nidhi Kaicker A, Lenhardt, Lwanga-Ntale C *et al*: **The Chronic Poverty Report: The road to zero extreme poverty**. In. London: Overseas Development Institute; 2014.

14. Hanna R, Oliva P: **Implications of Climate Change for Children in Developing Countries**. In., vol. 26: Springer; 2016.

15. Daoud A, Hallerod B, Guha-Sapir D: **What Is the Association between Absolute Child Poverty, Poor Governance, and Natural Disasters? A Global Comparison of Some of the Realities of Climate Change**. *PloS one* 2016, **11**(4):e0153296.

16. USAID: **Vision for Ending Extreme Poverty**. In. Washington U.S. Agency for International Development; 2015.

17. Oxford Poverty and Human Development Initiative (OPHI): **Global Multidimensional Poverty Index 2018: The most detailed picture to date of the world's poorest people**. In. University of Oxford: OPHI; 2018.

18. Newhouse D, Suarez-Becerra P, Evans MC, Data for Goals Group: **New Estimates of Extreme Poverty for Children**. In. Washington: World Bank Group, Poverty and Equity Global Practice Group; 2016.

19. Unicef, World Bank Group: **Ending extreme poverty: a focus on children**. In.; 2016.

20. World Poverty Statistics: **Global Poverty Report** In.; 2018.

21. Szilagyi MA, Rosen DS, Rubin D, Zlotnik S, Council On Foster Care A, Kinship C, Committee On A, Council On Early C: **Health Care Issues**

for Children and Adolescents in Foster Care and Kinship Care. *Pediatrics* 2015, **136**(4):e1142-1166.

22. Szilagyi M: **The Pediatrician and the Child in Foster Care**. *Pediatrics in Review* 1998, **19**(2):39-50.

23. Schofield G, Beek M: **Risk and Resilience in Long-Term Foster-Care**. *British Journal of Social Work* 2005, **35**:1-19.

24. World Bank: **Poverty and shared prosperity: Taking on inquality**. In. Washington, DC; 2016.

25. Walker SP, Wachs TD, Grantham-McGregor S, Black MM, Nelson CA, Huffman SL, Baker-Henningham H, Chang SM, Hamadani JD, Lozoff B *et al*: **Inequality in early childhood: risk and protective factors for early child development**. *The Lancet* 2011, **378**(9799):1325-1338.

26. Grantham-McGregor S, Cheung YB, Cueto S, Glewwe P, Richter L, Strupp B: **Developmental potential in the first 5 years for children in developing countries**. *The Lancet* 2007, **369**(9555):60-70.

27. Engle PL, Fernald LCH, Alderman H, Behrman J, O'Gara C, Yousafzai A, de Mello MC, Hidrobo M, Ulkuer N, Ertem I *et al*: **Strategies for reducing inequalities and improving developmental outcomes for young children in low-income and middle-income countries**. *The Lancet* 2011, **378**(9799):1339-1353.

28. Beatrice N, Lise G, Victoria ZM, Louise S: **Longitudinal patterns of poverty and health in early childhood: exploring the influence of concurrent, previous, and cumulative poverty on child health outcomes**. *BMC pediatrics* 2012, **12**:141.

29. Bailey RL, West Jr KP, Black RE: **The Epidemiology of Global Micronutrient Deficiencies**. *Annals of Nutrition and Metabolism* 2015, **66(suppl 2)**(Suppl. 2):22-33.

30. Walker SP, Wachs TD, Meeks Gardner J, Lozoff B, Wasserman GA, Pollitt E, Carter JA: **Child development: risk factors for adverse outcomes in developing countries**. *The Lancet* 2007, **369**(9556):145-157.

31. Chilton M, Chyatte M, Breaux J: **The negative effects of poverty and food insecurity on child development: review article**. *Indian J Med Res* 2007, **126**:262-272.

32. Petrou S, Kupek E: **Poverty and childhood undernutrition in developing countries: a multi-national cohort study**. *Social science & medicine* 2010, **71**(7):1366-1373.

33. Brown N, Finch JE, Obradović J, Yousafzai AK: **Maternal care mediates the effects of nutrition and responsive stimulation interventions on young children's growth**. *Child: Care, Health and Development* 2017, **43**(4):577-587.

34. Wolde T, Belachew T, Moges D: **Prevalence of Acute Malnutrition (Wasting) and Associated Factors among Preschool Children Aged 36-60 Months at Hawassa Zuria, South Ethiopia: A Community Based Cross Sectional Study**. *J Nutr Food Sci* 2016, **6**(2).

35. Central Statistical Agency (CSA) [Ethiopia] and ICF: **Ethiopia Demographic and Health Survey 2016**. In. Addis Ababa, Ethiopia, and Rockville, Maryland, USA: CSA and ICF; 2016.

36. de Onis M, Branca F: **Childhood stunting: a global perspective**. *Maternal & child nutrition* 2016, **12 Suppl 1**:12-26.

37. FAO: **Regional Overview of Food Security and Nutrition in Africa 2016: The challenges of building resilience to shocks and stresses.** In. Accra; 2017.

38. Vonaesch P, Tondeur L, Breurec S, Bata P, Nguyen LBL, Frank T, Farra A, Rafai C, Giles-Vernick T, Gody JC *et al*: **Factors associated with stunting in healthy children aged 5 years and less living in Bangui (RCA)**. *PloS one* 2017, **12**(8):e0182363.

39. Sobrino M, Gutierrez C, Alarcon J, Davila M, Cunha AJ: **Birth interval and stunting in children under five years of age in Peru (1996-2014)**. *Child Care Health Dev* 2017, **43**(1):97-103.

40. Adane M, Mengistie B, Kloos H, Medhin G, Mulat W: **Sanitation facilities, hygienic conditions, and prevalence of acute diarrhea among under-five children in slums of Addis Ababa, Ethiopia: Baseline survey of a longitudinal study**. *PloS one* 2017, **12**(8):e0182783.

41. Danaei G, Andrews KG, Sudfeld CR, Fink G, McCoy DC, Peet E, Sania A, Smith Fawzi MC, Ezzati M, Fawzi WW: **Risk Factors for Childhood Stunting in 137 Developing Countries: A Comparative Risk Assessment Analysis at Global, Regional, and Country Levels**. *PLoS medicine* 2016, **13**(11):e1002164.

42. Kavosi E, Hassanzadeh Rostami Z, Kavosi Z, Nasihatkon A, Moghadami M, Heidari M: **Prevalence and determinants of under-nutrition among children under six: a cross-sectional survey in Fars province, Iran**. *International journal of health policy and management* 2014, **3**(2):71-76.

43. Olack B, Burke H, Cosmas L, Bamrah S, Dooling K, Feikin DR, Talley LE, Breiman RF: **Nutritional Status of Under-five Children Living in an Informal Urban Settlement in Nairobi, Kenya**. *J HEALTH POPUL NUTR* 2011, **29**:357-363.

44. Akombi BJ, Agho KE, Merom D, Renzaho AM, Hall JJ: **Child malnutrition in sub-Saharan Africa: A meta-analysis of demographic and health surveys (2006-2016)**. *PloS one* 2017, **12**(5):e0177338.

45. Oruamabo RS: **Child malnutrition and the Millennium Development Goals: much haste but less speed?** *Archives of disease in childhood* 2015, **100 Suppl 1**:S19-22.

46. Horton S, Alderman H, Rivera JA: **The Challenge of Hunger and Malnutrition**. In. Copenhagen: Copenhagen Consensus Center; 2008.

47. UNICEF: **Child Poverty in the Post-2015 Agenda: Issue Brief**. In. New York: UNICEF's Division of Policy and Strategy; 2014.

48. Addison T, Andvig JC, Appleton S, ohning RB, Boland JJ, Cartier-Bresson J, Evans DB, Henry PB, Intriligator MD, S.Manne A *et al*: **Global Crises, Global Solutions**. New York: Cambridge University Press; 2004.

49. Victora CG, Adair L, Fall C, Hallal PC, Martorell R, Richter L, Sachdev HS: **Maternal and child undernutrition: consequences for adult health and human capital**. *The Lancet* 2008, **371**(9609):340-357.

50. International Food Policy Research Institute: **Global Nutrition Report 2016: From Promise to Impact: Ending Malnutrition by 2030**. In. Washington, DC; 2016.

51. Black RE, Allen LH, Bhutta ZA, Caulfield LE, de Onis M, Ezzati M, Mathers C, Rivera J: **Maternal and child undernutrition: global and regional exposures and health consequences**. *The Lancet* 2008, **371**(9608):243-260.

52. RE B: **Global distribution and disease burden related to micronutrient deficiencies**. In., vol. 78: Nestle Nutr Inst Workshop Ser.; 2014: 21-28.

53. Black R: **Micronutrient deficiency — an underlying cause of morbidity and mortality**. In., vol. 81. Geneva: Bulletin of the World Health Organization 2003.

54. Black MM: **Micronutrient Deficiencies and Cognitive Functioning**. *J Nutr* 2003, **133**.

55. Black MM: **Zinc deficiency and child development**. *Am J Clin Nutr* 1998, **68**:464S–469S.

56. Benton D: **Micronutrient status, cognition and behavioral problems in childhood**. *European journal of nutrition* 2008, **47**(3):38-50.

57. Ruducha J, Mann C, Singh NS, Gemebo TD, Tessema NS, Baschieri A, Friberg I, Zerfu TA, Yassin M, Franca GA *et al*: **How Ethiopia achieved Millennium Development Goal 4 through multisectoral**

interventions: a Countdown to 2015 case study. *The Lancet Global Health* 2017, **5**(11):e1142-e1151.

58. UNICEF: **Levels and Trends in Child Mortality: Estimates Developed by the UN Inter-agency Group for Child Mortality Estimation**. In. Edited by Hug L, Sharrow D, You D. New York; 2017.

59. Blair C, Raver CC: **Child development in the context of adversity: experiential canalization of brain and behavior**. *The American psychologist* 2012, **67**(4):309-318.

60. McEwen CA, McEwen BS: **Social Structure, Adversity, Toxic Stress, and Intergenerational Poverty: An Early Childhood Model**. *Annual Review of Sociology* 2017, **43**(1):445-472.

61. Richards M, Wadsworth ME: **Long term effects of early adversity on cognitive function**. *Archives of disease in childhood* 2004, **89**(10):922-927.

62. Black MM, Walker SP, Fernald LCH, Andersen CT, DiGirolamo AM, Lu C, McCoy DC, Fink G, Shawar YR, Shiffman J *et al*: **Early childhood development coming of age: science through the life course**. *The Lancet* 2017, **389**(10064):77-90.

63. Ismayilova L, Gaveras E, Blum A, To-Camier A, Nanema R: **Maltreatment and Mental Health Outcomes among Ultra-Poor Children in Burkina Faso: A Latent Class Analysis**. *PloS one* 2016, **11**(10):e0164790.

64. Marshall J: **Infant Neurosensory Development: Considerations for Infant Child Care**. *Early Childhood Education Journal* 2011, **39**(3):175-181.

65. Cutuli JJ, Montgomery AE, Evans-Chase M, Culhane DP: **Childhood adversity, adult homelessness and the intergenerational transmission of risk: a population-representative study of individuals in households with children**. *Child & Family Social Work* 2017, **22**(1):116-125.

66. Ribeiro DG, Perosa GB, Padovani FHP: **Mental health, mother-child interaction and development at the end of the first year of life**. *Paidéia (Ribeirão Preto)* 2014, **24**(59):331-339.

67. Tomlinson M, Morgan B: **Infant Mental Health Research in Africa: a call for action for research in the next 10 years**. In., vol. 2. Stellenbosch, South Africa.: Global mental health; 2015: 1-9.

68. Roben CK, Moore GA, Cole PM, Molenaar P, Leve LD, Shaw DS, Reiss D, Neiderhiser JM: **Transactional Patterns of Maternal Depressive Symptoms and Mother-Child Mutual Negativity in an Adoption Sample**. *Infant Child Dev* 2015, **24**(3):322-342.

69. Tomlinson M, Landman M: **'It's not just about food': mother–infant interaction and the wider context of nutrition**. *Maternal & child nutrition* 2007, **3**(4):292-302.

70. WHO: **The importance of caregiver–child interactions for the survival and healthy development of young children: a review**. In. Geneva, Switzerland: WHO Department of Child and Adolescent Health and Development (CAH); 2004.

71. Morris AS, Robinson LR, Hays-Grudo J, Claussen AH, Hartwig SA, Treat AE: **Targeting Parenting in Early Childhood: A Public Health Approach to Improve Outcomes for Children Living in Poverty**. *Child development* 2017, **88**(2):388-397.

72. Waters E, Cummings EM: **A Secure Base from Which to Explore Close Relationships**. *Child development* 2000, **71**(1):164-172.

73. Waters E, Crowell J, Elliott M, Corcoran D, Treboux D: **Bowlby's secure base theory and the social/personality psychology of attachment styles: Work(s) in progress**. *Attachment & human development* 2002, **4**(2):230-242.

74. Bowlby J: **Attachment theory and its therapeutic implications**. *Adolescent Psychiatry* 1978, **6**:5-33.

75. Milteer RM, Ginsburg KR, Council On C, Media, Committee On Psychosocial Aspects Of C, Family H: **The importance of play in promoting healthy child development and maintaining strong parent-child bond: focus on children in poverty**. *Pediatrics* 2012, **129**(1):e204-213.

76. WHO: **International Classification of Functioning, Disability and Healthy, Children & Youth Version (ICF-CY). Geneva: World Health Organization**. 2007.

77. ÜStÜN TB, Chatterji S, Bickenbach J, Kostanjsek N, Schneider M: **The International Classification of Functioning, Disability and Health: a new tool for understanding disability and health**. *Disability and Rehabilitation* 2003, **25**(11-12):565-571.

78. Badley EM: **Enhancing the conceptual clarity of the activity and participation components of the International Classification of Functioning, Disability, and Health**. *Social science & medicine* 2008, **66**(11):2335-2345.

79. Granlund M: **Participation – challenges in conceptualization, measurement and intervention**. *Child: Care, Health and Development* 2013, **39**(4):470-473.

80. Schneidert M, Hurst R, Miller J, ÜStÜN B: **The role of Environment in the International Classification of Functioning, Disability and Health (ICF)**. *Disability and Rehabilitation* 2003, **25**(11-12):588-595.

81. Raising Children Network (Australia): **Child development: the first five years**. In. Australia: Raisingchildren.net.au; 2018.

82. Committee on the Rights of the Child: **The Right of the Child to Rest, Leisure, Play, Recreational Activities, Cultural Life and the Arts**. In. New York: United Nations; 2013.

83. Vygotsky L: **Mind in society: The development of higher psychological processes.**: Cambridge, MA: Harvard University Press; 1978.

84. Yogman M, Garner A, Hutchinson J, al e, AAP, Committee on Psychosocial Aspects of Child and Family Health ACoCaM: **The Power of Play: A Pediatric Role in Enhancing Development in Young Children**. *Pediatrics* 2018.

85. Karamali Esmaili S, Shafaroodi N, Hassani Mehraban A, Parand A, Zarei M, Akbari-Zardkhaneh S: **Effect of Play-based Therapy on Meta-cognitive and Behavioral Aspects of Executive Function: A Randomized, Controlled, Clinical Trial on the Students With Learning Disabilities**. *Basic and clinical neuroscience* 2017, **8**(3):203-212.

86. Veiga G, de Leng W, Cachucho R, Ketelaar L, Kok JN, Knobbe A, Neto C, Rieffe C: **Social Competence at the Playground: Preschoolers During Recess**. *Infant and Child Development* 2017, **26**(1):e1957.

87. Fung W-k, Cheng RW-y: **Effect of School Pretend Play on Preschoolers' Social Competence in Peer Interactions: Gender as a Potential Moderator**. *Early Childhood Education Journal* 2015, **45**(1):35-42.

88. Stanton-Chapman TL: **Promoting Positive Peer Interactions in the Preschool Classroom: The Role and the Responsibility of the Teacher in Supporting Children's Sociodramatic Play**. *Early Childhood Educ J* 2015, **43**:99-107.

89. International Play Association: **Children's Right to Play and the Environment**. In. Copenhagen: IPA; 2016.

90. Harden BJ, Feola B, Morrison C, Brown S, Parra LJ, Wassman AB: **The Experiences and Effects of Toxic Stress on Young African American Children**. In: *African American Children in Early Childhood Education.* edn.; 2017: 165-200.

91. Harden BJ, Buhler A, Parra LJ: **Maltreatment in Infancy:A Developmental Perspective on Prevention and Intervention**. *Trauma, Violence, & Abuse* 2016, **17**(4):366-386.

92. Melzer DK, Palermo CA: **'Mommy, You are the Princess and I am the Queen': How Preschool Children's Initiation and Language Use During Pretend Play Relate to Complexity**. *Infant and Child Development* 2016, **25**(2):221-230.

93. Wasik BA, Jacobi-Vessels JL: **Word Play: Scaffolding Language Development Through Child-Directed Play**. *Early Childhood Education Journal* 2016, **45**(6):769-776.

94. Kemple KM, Oh J, Kenney E, Smith-Bonahue T: **The Power of Outdoor Play and Play in Natural Environments**. *Childhood Education* 2016, **92**(6):446-454.

95. Brussoni M, Olsen LL, Pike I, Sleet DA: **Risky play and children's safety: balancing priorities for optimal child development**. *International journal of environmental research and public health* 2012, **9**(9):3134-3148.

96. Engle PL, Menon P, Haddad L: **Care and Nutrition: Concepts and Measurement**. *World Development* 1999, **27**:1309-1337.

97. Yousafzai AK, Rasheed MA, Rizvi A, Armstrong R, Bhutta ZA: **Parenting Skills and Emotional Availability: An RCT**. *Pediatrics* 2015, **135**(5):e1247-1257.

98. Eshel N, Daelmans B, Mello MCd, Martines J: **Responsive parenting: interventions and outcomes**. *Bulletin of the World Health Organization* 2006, **84**:992-999.

99. National Scientific Council on the Developing Child: **Young Children Develop in an Environment of Relationships: Working Paper No. 1. Retrieved from www.developingchild.harvard.edu.** In.; 2004.

100. **Applying the Science of Child Development in Child Welfare Systems.**

101. Barth RP, Crea TM, John K, Thoburn J, Quinton D: **Beyond attachment theory and therapy: Towards sensitive and evidence-based**

interventions with foster and adoptive families in distress. *Child & Family Social Work* 2005, **10**(4):257-268.

102. Crockenberg SB: **Infant Irritability, Mother Responsiveness, and Social Support Influences on the Security of Infant-Mother Attachment**. *Child development* 1981, **52**(3):857-865.

103. Simmons BL, Gooty J, Nelson DL, Little LM: **Secure attachment: implications for hope, trust, burnout, and performance**. *Journal of Organizational Behavior* 2009, **30**(2):233-247.

104. Pollard EL, Lee PD: **Child Well-being: A Systematic Review of the Literature**. *Social Indicators Research* 2003, **61**(1):59-78.

105. Andrew A, Malde B: **Child Development and Policy Interventions in Developing Countries**. In: *Research at a glance: child development.* India: Institute for Fiscal Studies; 2014.

106. Hertzman C, Siddiqi A, Hertzman E, Irwin LG, Vaghri Z, Houweling TAJ, Bell R, Tinajero A, Marmot M: **Bucking the inequality gradient through early child development**. *Bmj* 2010, **340**.

107. American Academy of Pediatrics: **Developmental Issues for Young Children in Foster Care**. *Pediatrics* 2000, **106**.

108. **From Neurons to Neighborhoods: The Science of Early Childhood Development J. P. Shonkoff & D. A. Phillips (Eds.)**

109. WHO: **Early Child Development: A Powerful Equalizer**. In.: www.earlylearning.ubc.ca/WHO; 2007.

110. WHO: **The International Classification of Functioning, Disability and Health (ICF). Geneva: WHO. http://www.who.int/classifications/icf/en/** 2001.

111. Silva N, Bullinger M, Sommer R, Rohenkohl A, Witt S, Quitmann J: **Children's psychosocial functioning and parents' quality of life in paediatric short stature: The mediating role of caregiving stress**. *Clinical psychology & psychotherapy* 2018, **25**(1):e107-e118.

112. Yousafzai AK, Arabi M: **Bridging Survival and Development in the Post-2015 Agenda: partnerships in nut rition and early child development**. In. The Hague,: Early Childhood Matters; 2015.

113. Grantham-McGregor SM, Powell CA, Walker SP, Himes JH: **Nutritional supplementation, psychosocial stimulation, and mental development of stunted children: the Jamaican Study**. *The Lancet* 1991, **338**(8758):1-5.

114. Grantham-McGregor S, Walker S: **The Jamaican early childhood home visiting intervention**. In. Edited by Matters EC: Bernard van Leer Foundat ion; 2015.

115. Hamadani JD, Huda SN, Khatun F, Grantham-McGregor4 SM: **Psychosocial Stimulation Improves the Development of Undernourished Children in Rural Bangladesh**. *J Nutr* 2006, **136**:2645–2652.

116. Powell C, Baker-Henningham H, Walker S, Gernay J, Grantham-McGregor S: **Feasibility of integrating early stimulation into primary care for undernourished Jamaican children: cluster randomised controlled trial**. *Bmj* 2004.

117. Nahar B, Hossain MI, Hamadani JD, Ahmed T, Grantham-McGregor S, Persson L-A: **Effects of psychosocial stimulation on improving home environment and child-rearing practices: results from a community-based trial among severely malnourished children in Bangladesh**. *BMC public health* 2012, **12**.

118. Grantham-Mcgregor S, Stewart M, Schofield W: **EFFECT OF LONG-TERM PSYCHOSOCIAL STIMULATION ON MENTAL DEVELOPMENT OF SEVERELY MALNOURISHED CHILDREN**. *The Lancet* 1980, **316**(8198):785-789.

119. Walker S, Chang S, Powell C, Baker-Henningham H: **Building Human Capacity through Early Childhood Intervention: The Child Development Research Programme at the Tropical Medicine**

Research Institute, The University of the West Indies, Kingston, Jamaica. *West Indian Med J* 2012, **61**.

120. Hamadani JD, Nahar B, Huda SN, Tofail F: **Integrating early child development programs into health and nutrition services in Bangladesh: benefits and challenges**. *Annals of the New York Academy of Sciences* 2014, **1308**:192-203.

121. Nahar B, Hamadani JD, Ahmed T, Tofail F, Rahman A, Huda SN, Grantham-McGregor SM: **Effects of psychosocial stimulation on growth and development of severely malnourished children in a nutrition unit in Bangladesh**. *European journal of clinical nutrition* 2009, **63**(6):725-731.

122. Daniel AI, Bandsma RH, Lytvyn L, Voskuijl WP, Potani I, van den Heuvel M: **Psychosocial stimulation interventions for children with severe acute malnutrition: a systematic review**. *Journal of global health* 2017, **7**(1):010405.

123. Grantham-McGregor SM, Fernald LC, Kagawa RM, Walker S: **Effects of integrated child development and nutrition interventions on child development and nutritional status**. *Annals of the New York Academy of Sciences* 2014, **1308**:11-32.

124. Hurley KM, Yousafzai AK, Lopez-Boo F: **Early Child Development and Nutrition: A Review of the Benefits and Challenges of Implementing Integrated Interventions**. *Advances in nutrition* 2016, **7**(2):357-363.

125. Lu C, Black MM, Richter LM: **Risk of poor development in young children in low-income and middle-income countries: an estimation and analysis at the global, regional, and country level**. *The Lancet Global Health* 2016, **4**(12):e916-e922.

126. Gowani S, Yousafzai AK, Armstrong R, Bhutta ZA: **Cost effectiveness of responsive stimulation and nutrition interventions on early child development outcomes in Pakistan**. *Annals of the New York Academy of Sciences* 2014, **1308**:149-161.

127. Duncan KM, MacGillivray S, Renfrew MJ: **Costs and savings of parenting interventions: results of a systematic review**. *Child: Care, Health and Development* 2017, **43**(6):797-811.

128. Yousafzai AK, Obradović J, Rasheed MA, Rizvi A, Portilla XA, Tirado-Strayer N, Siyal S, Memon U: **Effects of responsive stimulation and nutrition interventions on children's development and growth at age 4 years in a disadvantaged population in Pakistan: a longitudinal follow-up of a cluster-randomised factorial effectiveness trial**. *The Lancet Global Health* 2016, **4**(8):e548-e558.

129. Nores M, Barnett WS: **Benefits of early childhood interventions across the world: (Under) Investing in the very young**. *Economics of Education Review* 2010, **29**(2):271-282.

130. Bovenschen I, Lang K, Zimmermann J, Förthner J, Nowacki K, Roland I, Spangler G: **Foster children's attachment behavior and representation: Influence of children's pre-placement experiences and foster caregiver's sensitivity**. *Child Abuse & Neglect* 2016, **51**(Supplement C):323-335.

131. Lang K, Bovenschen I, Gabler S, Zimmermann J, Nowacki K, Kliewer J, Spangler G: **Foster children's attachment security in the first year after placement: A longitudinal study of predictors**. *Early childhood research quarterly* 2016, **36**(Supplement C):269-280.

132. Fergeus J, Humphreys C, Harvey C, Herrman H: **Supporting foster and kinship carers to promote the mental health of children**. *Child & Family Social Work* 2018.

133. Jee SH, Szilagyi M, Ovenshire C, Norton A, Conn A-M, Blumkin A, Szilagyi PG: **Improved Detection of Developmental Delays Among Young Children in Foster Care**. *Pediatrics* 2010, **125**:282–289.

134. Jee SH, Conn AM, Szilagyi PG, Blumkin A, Baldwin CD, Szilagyi MA: **Identification of social-emotional problems among young children in foster care**. *Journal of child psychology and psychiatry, and allied disciplines* 2010, **51**(12):1351-1358.

135. Healey CV, Fisher PA: **Young children in foster care and the development of favorable outcomes**. *Children and Youth Services Review* 2011, **33**(10):1822–1830.

136. Dozier M, Peloso E, Lindhiem O, Gordon MK, Manni M, Sepulveda S, Ackerman J, Bernier A, Levine S: **Developing Evidence-Based Interventions for Foster Children: An Example of a Randomized Clinical Trial with Infants and Toddlers**. *Journal of Social Issues* 2006, **62**(4):767–785.

137. Leloux-Opmeer H, Kuiper C, Swaab H, Scholte E: **Similarities and Differences in the Psychosocial Development of Children Placed in Different 24-h Settings**. *Journal of child and family studies* 2017.

138. Hong YR, Park JS: **Impact of attachment, temperament and parenting on human development**. *Korean journal of pediatrics* 2012, **55**(12):449-454.

139. Garcia Quiroga M, Hamilton-Giachritsis C: **Attachment Styles in Children Living in Alternative Care: A Systematic Review of the Literature**. *Child & youth care forum* 2016, **45**:625-653.

140. Akhter D, Das SK, Chisti MJ, Imran G, Farzana FD, Ahmed S, Ferdous F, Malek MA, Faruque ASG: **Health and Nutritional Status of Young Foster Children Attending a Diarrhea Treatment Hospital in Bangladesh**. *Food and Nutrition Sciences* 2013, **04**(08):785-790.

141. Leinaweaver J: **Informal Kinship-Based Fostering Around the World: Anthropological Findings**. *Child Development Perspectives* 2014, **8**(3):131-136.

142. Tarren-Sweeney M, Hazell P: **Mental health of children in foster and kinship care in New South Wales, Australia**. *J Paediatr Child Health* 2006, **42**(3):89-97.

143. Enlow MB, Blood E, Egeland B: **Sociodemographic Risk, Developmental Competence, and PTSD Symptoms in Young Children Exposed to Interpersonal Trauma in Early Life**. *Journal of Traumatic Stress* 2013, **26**(6):686-694.

144. Goemans A, van Geel M, Vedder P: **Psychosocial functioning in Dutch foster children: The relationship with child, family, and placement characteristics**. *Child Abuse & Neglect* 2016, **56**(Supplement C):30-43.

145. Forsman H: **Foster carers' experiences of a paired reading literacy intervention with looked-after children**. *Child & Family Social Work* 2017, **22**(1):409-418.

146. Black MM, Perez-Escamilla R, Rao SF: **Integrating nutrition and child development interventions: scientific basis, evidence of impact, and implementation considerations**. *Advances in nutrition* 2015, **6**(6):852-859.

147. Yousafzai AK, Rasheed MA, Daelmans B, Manji S, Arnold C, Lingam R, Muskin J, Lucas JE: **Capacity building in the health sector to improve care for child nutrition and development**. *Annals of the New York Academy of Sciences* 2014, **1308**:172-182.

148. Engle P, Huffman SL: **Growing children's bodies and minds: Maximizing child nutrition and development**. *Food and Nutrition Bulletin* 2010, **31**.

149. DiGirolamo AM, Stansbery P, Lung'aho M: **Advantages and challenges of integration: opportunities for integrating early childhood development and nutrition programming**. *Annals of the New York Academy of Sciences* 2014, **1308**:46-53.

150. Abessa TG, Worku BN, Kibebew MW, Valy J, Lemmens J, Thijs H, Yimer WK, Kolsteren P, Granitzer M: **Adaptation and standardization of a Western tool for assessing child development in non-Western low-income context**. *BMC public health* 2016, **16**:652.

151. Squires J, Bricker D, Twombly E: **The ASQ:SE User's Guide for the Ages and Stages Questionnaires: Social-Emotional. A Parent Completed, Child-monitoring System for Social-Emotional Behaviors**. In. Baltimore, Maryland: Paul H: Brookes Publishing Co.; 2003.

152. Rubio-Codina M, Araujo MC, Attanasio O, Munoz P, Grantham-McGregor S: **Concurrent Validity and Feasibility of Short Tests Currently Used to Measure Early Childhood Development in Large Scale Studies**. *PloS one* 2016, **11**(8):e0160962.

153. Iles-Caven Y, Golding J, Gregory S, Emond A, Taylor CM: **Data relating to early child development in the Avon Longitudinal Study of Parents and Children (ALSPAC), their relationship with prenatal blood mercury and stratification by fish consumption**. *Data in brief* 2016, **9**:112-122.

154. Heo KH, Squires J: **Cultural adaptation of a parent completed social emotional screening instrument for young children: Ages and stages questionnaire-social emotional**. *Early human development* 2012, **88**(3):151-158.

155. Briggs RD, Stettler EM, Silver EJ, Schrag RDA, Nayak M, Chinitz S, Racine AD: **Social-Emotional Screening for Infants and Toddlers in Primary Care**. *Pediatrics* 2012, **129**(2):e377-e384.

156. Anunciação L, Chieh-Yu C, Squires J, J L-F: **Screening for Social and Emotional Delays in Young Children Who Live in Poverty: A Brazilian Example**. *Journal of Childhood & Developmental Disorders* 2018, **4**:1-4.

157. Worku BN, Abessa TG, Franssen E, Vanvuchelen M, Kolsteren P, Granitzer M: **Development, Social-Emotional Behavior and Resilience of Orphaned Children in a Family-Oriented Setting**. *Journal of child and family studies* 2018, **27**:465–474.

158. Fentahun W, Wubshet M, Tariku A: **Undernutrition and associated factors among children aged 6-59 months in East Belesa District, northwest Ethiopia: a community based cross-sectional study**. *BMC public health* 2016, **16**:506.

159. Santos DN, Assis AM, Bastos AC, Santos LM, Santos CA, Strina A, Prado MS, Almeida-Filho NM, Rodrigues LC, Barreto ML: **Determinants of**

cognitive function in childhood: a cohort study in a middle income context. *BMC public health* 2008, **8**:202.

160. Olney DK, Kariger PK, Stoltzfus RJ, Khalfan SS, Ali NS, Tielsch JM, Sazawal S, Black R, Allen LH, Pollitt E: **Development of nutritionally at-risk young children is predicted by malaria, anemia, and stunting in Pemba, Zanzibar**. *The Journal of nutrition* 2009, **139**(4):763-772.

161. Crookston BT, Penny ME, Alder SC, Dickerson TT, Merrill RM, Stanford JB, Porucznik CA, Dearden KA: **Children who recover from early stunting and children who are not stunted demonstrate similar levels of cognition**. *The Journal of nutrition* 2010, **140**(11):1996-2001.

162. Prendergast AJ, Humphrey JH: **The stunting syndrome in developing countries**. *Paediatrics and international child health* 2014, **34**(4):250-265.

163. Bass JK, Nakasujja N, Familiar-Lopez I, Sikorskii A, Murray SM, Opoka R, Augustinavicius J, Boivin MJ: **Association of caregiver quality of care with neurocognitive outcomes in HIV-affected children aged 2-5 years in Uganda**. *AIDS care* 2016, **28 Suppl 1**:76-83.

164. MUDHCo: **State of Ethiopian cities report**. In. Addis Ababa, Ethiopia; 2015.

165. Neubourg Cd, Chai J, Milliano Md, Plavgo I, Wei Z: **'Cross-country MODA Study: Multiple Overlapping Deprivation Analysis (MODA)-Technical Note,' Working Paper 2012-05**. In. Florence: UNICEF Office of Research; 2012.

166. Alkire S, Santos ME: **Multidimensional Poverty Index**. In.; 2010.

167. Alkire S: **Multidimensional Poverty and its Discontents**. In.; 2011.

168. World Health Organization: **Training Course on Child Growth Assessment**. In. Geneva: WHO; 2008.

169. Frankenburg WK, Dodds JB, Archer P, Bresnick B, Maschka P, Edelman N, Shapiro H: **Denver II Traning Manual**. In. Denver, Colorado: Denver Developmental Materials, Inc.; 1992.

170. Squires J, Bricker D, Heo K, Twombly E: **Identification of social-emotional problems in young children using a parent-completed screening measure**. *Early childhood research quarterly* 2001, **16**:405-419.

171. WHO: **WHO Anthro Software (version 3.2.2, January 2011) and macros**. In. Geneva, Switzerland: WHO Anthro; 2011.

172. Haile D, Azage M, Mola T, Rainey R: **Exploring spatial variations and factors associated with childhood stunting in Ethiopia: spatial and multilevel analysis**. *BMC pediatrics* 2016, **16**:49.

173. Sun J, Patel F, Rose-Jacobs R, Frank DA, Black MM, Chilton M: **Mothers' Adverse Childhood Experiences and Their Young Children's Development**. *American journal of preventive medicine* 2017.

174. Motbainor A, Worku A, Kumie A: **Stunting Is Associated with Food Diversity while Wasting with Food Insecurity among Underfive Children in East and West Gojjam Zones of Amhara Region, Ethiopia**. *PloS one* 2015, **10**(8):e0133542.

175. Rubio-Codina M, Attanasio O, Meghir C, Varela N, Grantham-McGregor S: **The socio-economic gradient of child development: cross-sectional evidence from children 6-42 months in Bogota**. In. Colombia: Inter-American Development Bank (IDB), social protection and health division; 2013.

176. Jensen SKG, Berens AE, Nelson CA: **Effects of poverty on interacting biological systems underlying child development**. *The Lancet Child & Adolescent Health* 2017.

177. Benton D, a.i.s.b.l IE: **Micronutrient status, cognition and behavioral problems in childhood**. *European journal of nutrition* 2008, **47 Suppl 3**:38-50.

178. McCoy DC, Connors MC, Morris PA, Yoshikawa H, Friedman-Krauss AH: **Neighborhood Economic Disadvantage and Children's Cognitive and Social-Emotional Development: Exploring Head Start Classroom Quality as a Mediating Mechanism**. *Early childhood research quarterly* 2015, **32**:150-159.

179. Hadley C, Tegegn A, Tessema F, Asefa M, Galea S: **Parental symptoms of common mental disorders and children's social, motor, and language development in sub-Saharan Africa**. *Annals of human biology* 2008, **35**(3):259-275.

180. Chang SM, Walker SP, Grantham-McGregor S, Powell CA: **Early childhood stunting and later fine motor abilities**. *Developmental medicine and child neurology* 2010, **52**(9):831-836.

181. Sudfeld CR, McCoy DC, Danaei G, Fink G, Ezzati M, Andrews KG, Fawzi WW: **Linear growth and child development in low- and middle-income countries: a meta-analysis**. *Pediatrics* 2015, **135**(5):e1266-1275.

182. Cheung YB, Yip PSF, Karlberg JPE: **Fetal growth, early postnatal growth and motor development in Pakistani infants**. *International journal of epidemiology* 2001, **30**:66-74.

183. Bain LE, Awah PK, Geraldine N, Kindong NP, Sigal Y, Bernard N, Tanjeko AT: **Malnutrition in Sub-Saharan Africa: burden, causes and prospects**. *The Pan African medical journal* 2013, **15**:120.

184. Ali SS: **A brief review of risk-factors for growth and developmental delay among preschool children in developing countries**. *Advanced Biomedical Research* 2013, **2**:91.

185. Prado EL, Abbeddou S, Adu-Afarwuah S, Arimond M, Ashorn P, Ashorn U, Brown KH, Hess SY, Lartey A, Maleta K *et al*: **Linear Growth and Child Development in Burkina Faso, Ghana, and Malawi**. *Pediatrics* 2016, **138**.

186. Iannotti L, Jean Louis Dulience S, Wolff P, Cox K, Lesorogol C, Kohl P: **Nutrition factors predict earlier acquisition of motor and**

language milestones among young children in Haiti. *Acta Paediatrica* 2016, **105**(9):e406-e411.

187. Erickson SJ, Montague EQ, Maclean PC, Bancroft ME, Lowe JR: **Differential ethnic associations between maternal flexibility and play sophistication in toddlers born very low birth weight**. *Infant behavior & development* 2012, **35**(4):860-869.

188. Jimenez ME, Wade R, Jr., Lin Y, Morrow LM, Reichman NE: **Adverse Experiences in Early Childhood and Kindergarten Outcomes**. *Pediatrics* 2016, **137**(2):e20151839.

189. Kernan M: **Play as a context for early learning and development**. In. 24 Merrion Square, Dublin 2, Ireland: National Council for Curriculum and Assessment, NCCA; 2007: 1-41.

190. Vernon-Feagans L, Bratsch-Hines ME, The Family Life Project Key Investigators: **Caregiver-Child Verbal Interactions in Child Care: A Buffer against Poor Language Outcomes when Maternal Language Input is Less**. *Early childhood research quarterly* 2013, **28**(4):858-873.

191. Parfitt Y, Pike A, Ayers S: **Infant Developmental Outcomes: A Family Systems Perspective**. *Infant and Child Development* 2014, **23**(4):353-373.

192. Malekpour M: **Effects of attachment on early and later development**. *The British Journal of Developmental Disabilities* 2007, **53**:81-95.

193. Vernon-Feagans L, Garrett-Peters P, Willoughby M, Mills-Koonce R, The Family Life Project Key I: **Chaos, Poverty, and Parenting: Predictors of Early Language Development**. *Early childhood research quarterly* 2012, **27**(3):339-351.

194. Gulay H, Seven S, Damar M: **The effects gross motor skills in pre-school children have on their peer relation and social status**. *Res J Biol Sci* 2010, **5**:722-726.

195. Glascoe FP, Byrne KE, Ashford LG, Johnson KL, Chang B, Strickland B: **Accuracy of the Denver-II in developmental screening**. *Pediatrics* 1992, **89**:1221-1225.

196. Asfaw M, Wondaferash M, Taha M, Dube L: **Prevalence of undernutrition and associated factors among children aged between six to fifty nine months in Bule Hora district, South Ethiopia**. *BMC public health* 2015, **15**:41.

197. El-Sherif AM, Babrs GM, Ismail AM: **Cranial Magnetic Resonance Imaging (MRI) changes in severely malnourished children before and after treatment**. *Life Science Journal* 2012, **9**:738-742.

198. Bornstein MH, Putnick DL: **Cognitive and socioemotional caregiving in developing countries**. *Child development* 2012, **83**(1):46-61.

199. Obradovic J, Yousafzai AK, Finch JE, Rasheed MA: **Maternal scaffolding and home stimulation: Key mediators of early intervention effects on children's cognitive development**. *Developmental psychology* 2016, **52**(9):1409-1421.

200. Gertler P, Heckman J, Pinto R, Zanolini A, Vermeerch C, Walker S, Chang SM, Grantham-McGregor S: **Labor Market Returns to Early Childhood Stimulation: A 20-year Followup to an Experimental Intervention in Jamaica." IRLE Working Paper No. 142-13.** In. Berkeley, University of California: Institute for research on labor and employment (IRLE); 2013.

201. Attanasio OP, Fernandez C, Fitzsimons EO, Grantham-McGregor SM, Meghir C, Rubio-Codina M: **Using the infrastructure of a conditional cash transfer program to deliver a scalable integrated early child development program in Colombia: cluster randomized controlled trial**. *Bmj* 2014, **349**:g5785.

202. Baker-Henningham H, Boo FL: **Early Childhood Stimulation Interventions in Developing Countries: A comprehensive literature review**. In.: Banco Interamericano de Desarrollo (BID); 2010.

203. Sweet MA, Appelbaum MI: **Is Home Visiting an Effective Strategy? A Meta-Analytic Review of Home Visiting Programs for Families With Young Children**. *Child development* 2004, **75**:1435-1456.

204. Singla DR, Kumbakumba E, Aboud FE: **Effects of a parenting intervention to address maternal psychological wellbeing and child development and growth in rural Uganda: a community-based, cluster-randomised trial**. *The Lancet Global Health* 2015, **3**(8):e458-e469.

205. Kagitcibasi C, Sunar D, Bekman S: **Long-term effects of early intervention: Turkish low-income mothers and children**. *Applied Developmental Psychology* 2001, **22**:333-361.

206. Andrade SA, Santos DN, Bastos AC, Pedromônico MRM, Almeida-Filho N, Barreto ML: **Family environment and child's cognitive development: an epidemiological approach**. *Rev Saude Publica* 2005, **39**(4).

207. Hartinger SM, Lanata CF, Hattendorf J, Wolf J, Gil AI, Obando MO, Noblega M, Verastegui H, Mausezahl D: **Impact of a child stimulation intervention on early child development in rural Peru: a cluster randomised trial using a reciprocal control design**. *Journal of epidemiology and community health* 2017, **71**(3):217-224.

208. Denboba AD, Sayre RK, Wodon QT, Elder LK, Rawlings LB, Lombardi J: **Stepping up Early Childhood Development: Investing in Young Children for High Returns**. In.; 2014.

209. Worku BN, Abessa TG, Wondafrash M, Vanvuchelen M, Bruckers L, Kolsteren P, Granitzer M: **The relationship of undernutrition/psychosocial factors and developmental outcomes of children in extreme poverty in Ethiopia**. *BMC pediatrics* 2018, **18**(1):45.

210. Yoshikawa H, Kabay S: **The Evidence Base on Early Childhood Care and Education in Global Contexts: Background Paper for the**

UNESCO 2015 Education for All Global Monitoring Report. In. New York; 2015.

211. Young Lives: **Ways Forward for Early Learning in Ethiopia**. 2012.

212. Young Lives: **Early Childhood Care and Education as a Strategy for Poverty Reduction: Evidence from Young Lives**. In.; 2010.

213. Walker SP, Chang SM, Vera-Hernández M, Grantham-McGregor S: **Early Childhood Stimulation Benefits Adult Competence and Reduces Violent Behavior**. *Pediatrics* 2011, **127**.

214. Neuman MJ, Devercelli AE: **Early Childhood Policies in Sub-Saharan Africa: Challenges and Opportunities**. *International Journal of Child Care and Education Policy* 2012, **6**:21-34.

215. Engle PL, Black MM, Behrman JR, Mello MCd, Gertler PJ, Kapiriri L, Martorell R, Young ME, the International Child Development Steering Group: **Strategies to avoid the loss of developmental potential in more than 200 million children in the developing world**. *Lancet* 2007, **369**:229–242.

216. Rosner B: **Fundamentals of Biostatistics (6th edition)**: Harvard University, USA; 2006.

217. Lemmens J, Valy J, Granitzer M: **'Het "Stimulate-Enjoy-Safety" (SES) programma: spelbegeleiding van ondervoede kinderen in Ethiopië: rol van de ergotherapeut!'**. In: *'Ergotherapie'.* 2011.

218. Wallander JL, Bann CM, Biasini FJ, Goudar SS, Pasha O, Chomba E, McClure E, Carlo WA: **Development of children at risk for adverse outcomes participating in early intervention in developing countries: a randomized controlled trial**. *Journal of child psychology and psychiatry, and allied disciplines* 2014, **55**(11):1251-1259.

219. Powell C, Grantham-McGregor S: **Home Visiting of Varying Frequency and Child Development**. *Pediatrics* 1989, **84**:157.

220. Squires J, Brickers D, Twombly E: **The Ages and Stages Questionnaires: Social-Emotional (ASQ: SE) User's Guide**. In. Baltimore, USA: Paul H. Brookes Publishing Co.; 2002.

221. American Medical Association: **WorldMedical Association Declaration of Helsinki Ethical Principles for Medical Research Involving Human Subjects: Clinical Review & Education, Special Communication**. In. Edited by World Medical Association; 2013.

222. Bennett S, Myatt M, Jolley D, Radalowicz A: **Data management for surveys and trial: a practical primer using EpiData**. In.: The EpiData Association; 2001.

223. Liu J, Colditz GA: **Optimal design of longitudinal data analysis using generalized estimating equation models**. *Biometrical Journal* 2017, **59**(2):315-330.

224. Ballinger GA: **Using Generalized Estimating Equations for Longitudinal Data Analysis**. *Organizational Research Methods* 2016, **7**(2):127-150.

225. **Computation of Effect Sizes [Internet]. Available from: https://www.psychometrica.de/effect_size.html.**

226. Cohen J: **A power primer.** *Psychological Bulletin* 1992, **112**:155–159.

227. Cohen J: **Statistical power analysis for the behavioral sciences (2nd ed.).** Hillsdale, NJ: Erlbaum; 1988.

228. Hayes AF, Rockwood NJ: **Regression-based statistical mediation and moderation analysis in clinical research: Observations, recommendations, and implementation**. *Behaviour Research and Therapy* 2016.

229. Wallander JL, Biasini FJ, Thorsten V, Dhaded SM, Jong DMd, Chomba E, Pasha O, Goudar S, Wallace D, Chakraborty H *et al*: **Dose of early intervention treatment during children's first 36 months of life is associated with developmental outcomes: an observational**

cohort study in three low/low-middle income countries. *BMC pediatrics* 2014, **14**:281.

230. Suskind DL, Leffel KR, Graf E, Hernandez MW, Gunderson EA, Sapolich SG, Suskind E, Leininger L, Goldin-Meadow S, Levine SC: **A parent-directed language intervention for children of low socioeconomic status: a randomized controlled pilot study**. *Journal of Child Language* 2016, **43**(2):366-406.

231. Nicholson JM, Cann W, Matthews J, Berthelsen D, Ukoumunne OC, Trajanovska M, Bennetts SK, Hillgrove T, Hamilton V, Westrupp E *et al*: **Enhancing the early home learning environment through a brief group parenting intervention: study protocol for a cluster randomised controlled trial**. *BMC pediatrics* 2016, **16**:73.

232. Landry SH, Smith KE, Swank PR, Guttentag C: **A responsive parenting intervention: the optimal timing across early childhood for impacting maternal behaviors and child outcomes**. *Developmental psychology* 2008, **44**(5):1335-1353.

233. Landry SH, Smith KE, Swank PR: **Responsive Parenting: Establishing Early Foundations for Social, Communication, and Independent Problem-Solving Skills**. *Developmental psychology* 2006:627-642.

234. Coffin DA, Gropack SJ, Ronan-Grosshtern M, Supawadee L: **The Effect of a Community-Based Program on the Development of At-Risk Preschoolers**. *American Journal of Occupational Therapy* 2015, **69**(Supplement_1):6911515235p6911515231-6911515235p6911515231.

235. Lakens D: **Calculating and reporting effect sizes to facilitate cumulative science: a practical primer for t-tests and ANOVAs**. *Frontiers in psychology* 2013, **4**:863.

236. Case-Smith J, Frolek Clark GJ, Schlabach TL: **Systematic Review of Interventions Used in Occupational Therapy to Promote Motor Performance for Children Ages Birth–5 Years**. *American Journal of Occupational Therapy* 2013, **67**(4):413-424.

237. Abdul Latif Jameel Poverty Action Lab: **Early childhood engagement for lifelong learning**. In.: J-PAL; 2016.

238. Hutcheson JJ, Black MM, Talley M, Dubowitz H, Howard JB: **Risk Status and Home Intervention Among Children with Failure-to-Thrive: Follow-Up at Age 4**. *Journal of Pediatric Psychology* 1997, **22**:651-668.

239. Janssens W, Rosemberg C: **The impact of a Caribbean home-visiting child development program on cognitive skills**. *Economics of Education Review* 2014, **39**:22-37.

240. Bornstein MH, Putnick DL: **Mothers' and Fathers' Parenting Practices with Their Daugters and Sons in Low- and Middle-Income Countries**. *Monographs of the Society for Research in Child Development* 2016, **81**(1):60-77.

241. Sabanathan S, Wills B, Gladstone M: **Child development assessment tools in low-income and middle-income countries: how can we use them more appropriately?** *Archives of disease in childhood* 2015, **100**(5):482-488.

242. Gladstone MJ, Lancaster GA, Jones AP, Maleta K, Mtitimila E, Ashorn P, Smyth RL: **Can Western developmental screening tools be modified for use in a rural Malawian setting?** *Archives of disease in childhood* 2008, **93**(1):23-29.

243. Gladstone M, Lancaster GA, Umar E, Nyirenda M, Kayira E, van den Broek NR, Smyth RL: **The Malawi Developmental Assessment Tool (MDAT): the creation, validation, and reliability of a tool to assess child development in rural African settings**. *PLoS medicine* 2010, **7**(5):e1000273.

244. McCoy DC, Peet ED, Ezzati M, Danaei G, Black MM, Sudfeld CR, Fawzi W, Fink G: **Early Childhood Developmental Status in Low- and Middle-Income Countries: National, Regional, and Global Prevalence Estimates Using Predictive Modeling**. *PLoS medicine* 2016, **13**(6):e1002034.

245. Westgard C, Alnasser Y: **Developmental delay in the Amazon: The social determinants and prevalence among rural communities in Peru**. *PloS one* 2017, **12**(10):e0186263.

246. Fernald A, Marchman VA, Weisleder A: **SES differences in language processing skill and vocabulary are evident at 18 months**. *Developmental science* 2013, **16**(2):234-248.

247. Becker B: **Social disparities in children's vocabulary in early childhood. Does pre-school education help to close the gap?** *The British journal of sociology* 2011, **62**(1):69-88.

248. Tran TD, Luchters S, Fisher J: **Early childhood development: impact of national human development, family poverty, parenting practices and access to early childhood education**. *Child: Care, Health and Development* 2017, **43**(3):415-426.

249. Burger K: **How does early childhood care and education affect cognitive development? An international review of the effects of early interventions for children from different social backgrounds**. *Early childhood research quarterly* 2010, **25**(2):140-165.

250. Sharkins KA, Leger SE, Ernest JM: **Examining Effects of Poverty, Maternal Depression, and Children's Self-Regulation Abilities on the Development of Language and Cognition in Early Childhood: An Early Head Start Perspective**. *Early Childhood Education Journal* 2016, **45**(4):493-498.

251. Ford ND, Stein AD: **Risk factors affecting child cognitive development: a summary of nutrition, environment, and maternal-child interaction indicators for sub-Saharan Africa**. *Journal of developmental origins of health and disease* 2016, **7**(2):197-217.

252. Gershoff ET, Aber JL, Raver CC, Lennon MC: **Income Is Not Enough: Incorporating Material Hardship Into Models of Income Associations With Parenting and Child Development**. *Child development* 2007, **78**:70 – 95.

253. Huang J, Kim Y, Sherraden M: **Material hardship and children's social-emotional development: Testing mitigating effects of Child Development Accounts in a randomized experiment**. *Child: Care, Health and Development* 2017, **43**(1):89-96.

254. Chaudry A, Wimer C: **Poverty is Not Just an Indicator: The Relationship Between Income, Poverty, and Child Well-Being**. *Academic pediatrics* 2016, **16**(3 Suppl):S23-29.

255. UNICEF: **Unicef's Programme Guidance for Early Childhood Development**. In. New York, USA: United Nations Children's Fund (UNICEF); 2017.

256. The Science of Early Childhood Development: **National Scientific Council on the Developing Child. http://www.developingchild.net**. In.; 2007.

257. Dreyer BP: **Global Sustainable Development Starts With Investment in the Early Brain Development of Children**. *Pediatrics* 2016, **137**.

258. Lloyd-Fox S, Begus K, Halliday D, Pirazzoli L, Blasi A, Papademetriou M, Darboe MK, Prentice AM, Johnson MH, Moore SE *et al*: **Cortical specialisation to social stimuli from the first days to the second year of life: A rural Gambian cohort**. *Developmental cognitive neuroscience* 2017, **25**:92-104.

259. UNICEF: **Early Moments Matter**. In. New York: United Nations Children's Fund (UNICEF),; 2017.

260. Guerrant RL, DeBoer MD, Moore SR, Scharf RJ, Lima AA: **The impoverished gut--a triple burden of diarrhoea, stunting and chronic disease**. *Nature reviews Gastroenterology & hepatology* 2013, **10**(4):220-229.

261. Chandrasekhar S, Aguayo VM, Krishna V, Nair R: **Household food insecurity and children's dietary diversity and nutrition in India. Evidence from the comprehensive nutrition survey in Maharashtra**. *Maternal & child nutrition* 2017, **13 Suppl 2**.

262. Sreeramareddy CT, Ramakrishnareddy N, Subramaniam M: **Association between household food access insecurity and nutritional status indicators among children aged <5 years in Nepal: results from a national, cross-sectional household survey**. *Public health nutrition* 2015, **18**(16):2906-2914.

263. Singh A, Singh A, Ram F: **Household food insecurity and nutritional status of children and women in Nepal**. *Food and Nutrition Bulletin* 2014, **35**.

264. Jones AD: **Household Food Insecurity is Associated with Heterogeneous Patterns of Diet Quality Across Urban and Rural Regions of Malawi**. *World Medical & Health Policy* 2015, **7**(3):234-254.

265. Endris N, Asefa H, Dube L: **Prevalence of Malnutrition and Associated Factors among Children in Rural Ethiopia**. *BioMed research international* 2017, **2017**:6587853.

266. Kar BR, Rao SL, Chandramouli BA: **Cognitive development in children with chronic protein energy malnutrition**. *Behavioral and brain functions : BBF* 2008, **4**:31.

267. Casale D, Desmond C, Richter L: **The association between stunting and psychosocial development among preschool children: a study using the South African Birth to Twenty cohort data**. *Child Care Health Dev* 2014, **40**(6):900-910.

268. Perkins JM, Kim R, Krishna A, McGovern M, Aguayo VM, Subramanian SV: **Understanding the association between stunting and child development in low- and middle-income countries: Next steps for research and intervention**. *Social science & medicine* 2017, **193**:101-109.

269. Bradley RH, Putnick DL: **Housing Quality and Access to Material and Learning Resources Within the Home Environment in Developing Countries**. *Child development* 2012, **83**(1):76-91.

270. Ginsburg KR, American Academy of Pediatrics Committee on C, American Academy of Pediatrics Committee on Psychosocial Aspects of

C, Family H: **The importance of play in promoting healthy child development and maintaining strong parent-child bonds**. *Pediatrics* 2007, **119**(1):182-191.

271. Weber A, Fernald A, Diop Y: **When Cultural Norms Discourage Talking to Babies: Effectiveness of a Parenting Program in Rural Senegal**. *Child development* 2017, **88**(5):1513-1526.

272. Menashe-Grinberg A, Atzaba-Poria N: **Mother-Child and Father-Child Play Interaction: The Importance of Parental Playfulness as a Moderator of the Links between Parental Behavior and Child Negativity**. *Infant Ment Health J* 2017, **38**(6):772-784.

273. Cabrera NJ, Karberg E, Malin JL, Aldoney D: **The Magic of Play: Low-Income Mothers' and Fathers' Playfulness and Children's Emotion Regulation and Vocabulary Skills**. *Infant Ment Health J* 2017, **38**(6):757-771.

274. Mori S, Nakamoto H, Mizuochi H, Ikudome S, Gabbard C: **Influence of Affordances in the Home Environment on Motor Development of Young Children in Japan**. *Child Development Research* 2013, **2013**:1-5.

275. Sills J, Rowse G, Emerson LM: **The role of collaboration in the cognitive development of young children: a systematic review**. *Child Care Health Dev* 2016, **42**(3):313-324.

276. Mok PL, Pickles A, Durkin K, Conti-Ramsden G: **Longitudinal trajectories of peer relations in children with specific language impairment**. *Journal of child psychology and psychiatry, and allied disciplines* 2014, **55**(5):516-527.

277. Reinhardt K, Fanzo J: **Addressing Chronic Malnutrition through Multi-Sectoral, Sustainable Approaches: A Review of the Causes and Consequences**. *Frontiers in nutrition* 2014, **1**:13.

278. Behrman JR, Schott W, Duc LT, Mani S, Fernald LCH, Stein AD, Crookston BT, Dearden K: **Intergenerational Transmission of Poverty and Inequality: Parental Resources and Schooling**

Attainment and Children's Human Capital in Ethiopia, India, Peru, and Vietnam. In.: The University of Chicago; 2017.

279. Aizer A: **The Role of Children's Health in the Intergenerational Transmission of Economic Status**. *Child Development Perspectives* 2017, **11**(3):167-172.

280. Walker SP, Chang SM, Wright A, Osmond C, Grantham-McGregor SM: **Early childhood stunting is associated with lower developmental levels in the subsequent generation of children**. *The Journal of nutrition* 2015, **145**(4):823-828.

281. Barboza GE: **Latent Classes and Cumulative Impacts of Adverse Childhood Experiences**. *Child maltreatment* 2018, **23**(2):111-125.

282. Behrman JR, Schott W, Mani S, Crookston BT, Dearden K, Duc LT, Fernald LCH, Stein AD: **Intergenerational Transmission of Poverty and Inequality: Parental Resources and Schooling Attainment and Children's Human Capital in Ethiopia, India, Peru, and Vietnam**. In. Chicago: University of Chicago; 2017.

283. WHO-CSDH: **Closing the gap in a generation: health equity through action on the social determinants of health. Final Report of the Commission on Social Determinants of Health.** In. Geneva: World Health Organization.; 2008.

284. Dawson-McClure S, Calzada E, Huang K-Y, Kamboukos D, Rhule D, Kolawole B, Petkova E, Brotman LM: **A Population-Level Approach to Promoting Healthy Child Development and School Success in Low-Income, Urban Neighborhoods: Impact on Parenting and Child Conduct Problems**. *Prevention Science* 2015, **16**(2):279-290.

285. Raikes HH, Roggman LA, Peterson CA, Brooks-Gunn J, Chazan-Cohen R, Zhang X, Schiffman RF: **Theories of change and outcomes in home-based Early Head Start programs**. *Early childhood research quarterly* 2014, **29**(4):574-585.

286. Harden BJ, Sandstrom H, Chazan-Cohen R: **Early Head Start and African American families: Impacts and mechanisms of child outcomes**. *Early childhood research quarterly* 2012, **27**(4):572-581.

287. Kellar-Guenther Y, Rosenberg SA, Block SR, Robinson CC: **Parent involvement in early intervention: what role does setting play?** *Early Years* 2014, **34**(1):81-93.

288. Sayre RK, Devercelli AE, Neuman MJ, Wodon Q: **Investing in Early Childhood Development: Review of the World Bank's Recent Experience**. In. Washington DC The World Bank; 2015.

289. Bassett L, Nieto A: **The Early Childhood Development Action Network: a global network to strengthen support for young children**. In.: Early Childhood Matters; 2017.

290. Dua T, Tomlinson M, Tablante E, Britto P, Yousfzai A, Daelmans B, Darmstadt GL: **Global research priorities to accelerate early child development in the sustainable development era**. *The Lancet Global Health* 2016, **4**(12):e887-e889.

291. Yousafzai AK, Rasheed MA, Rizvi A, Armstrong R, Bhutta ZA: **Effect of integrated responsive stimulation and nutrition interventions in the Lady Health Worker programme in Pakistan on child development, growth, and health outcomes: a cluster-randomised factorial effectiveness trial**. *The Lancet* 2014, **384**(9950):1282-1293.

292. Walker SP, Chang SM, Younger N, Grantham-Mcgregor SM: **The effect of psychosocial stimulation on cognition and behaviour at 6 years in a cohort of term, low-birthweight Jamaican children**. *Developmental Medicine & Child Neurology* 2010, **52**(7):e148-e154.

293. Silva GA, Costa KA, Giugliani ER: **Infant feeding: beyond the nutritional aspects**. *Jornal de pediatria* 2016, **92**(3 Suppl 1):S2-7.

294. Kabeta Daba A, Erango Ersado M: **Impact of Community Based Management of Acute Malnutrition Integrated Nutrition Education on Infant and Young Child Feeding Knowledge and**

Practice of Mothers or Caregivers in Dilla Zuria Woreda, Southern Ethiopia: A Quasi Experimental Study. *Family Medicine & Medical Science Research* 2015, **4**(5).

295. Aboud FE, Singla DR, Nahil MI, Borisova I: **Effectiveness of a parenting program in Bangladesh to address early childhood health, growth and development**. *Social science & medicine* 2013, **97**:250-258.

296. Black MM, Dewey KG: **Promoting equity through integrated early child development and nutrition interventions**. *Annals of the New York Academy of Sciences* 2014, **1308**:1-10.

297. Hoddinott J, Maluccio JA, Behrman JR, Flores R, Martorell R: **Effect of a nutrition intervention during early childhood on economic productivity in Guatemalan adults**. *The Lancet* 2008, **371**(9610):411-416.

298. Alderman H, Behrman JR, Grantham-McGregor S, Lopez-Boo F, Urzua S: **Economic perspectives on integrating early child stimulation with nutritional interventions**. *Annals of the New York Academy of Sciences* 2014, **1308**:129-138.

299. Richter LM, Daelmans B, Lombardi J, Heymann J, Boo FL, Behrman JR, Lu C, Lucas JE, Perez-Escamilla R, Dua T *et al*: **Investing in the foundation of sustainable development: pathways to scale up for early childhood development**. *The Lancet* 2017, **389**(10064):103-118.

300. Britto PR, Lye SJ, Proulx K, Yousafzai AK, Matthews SG, Vaivada T, Perez-Escamilla R, Rao N, Ip P, Fernald LCH *et al*: **Nurturing care: promoting early childhood development**. *The Lancet* 2017, **389**(10064):91-102.

301. Haq Z: **Promoting Early Childhood Development Through Community Health Worker Interventions: Implementation and Measurement Issues In Rural Pakistan.(Doctoral dissertation).**

Retrieved from http://scholarcommons.sc.edu/etd/2518. In.: University of South Carolina - Columbia; 2013.

302. Shawar YR, Shiffman J: **Generation of global political priority for early childhood development: the challenges of framing and governance**. *The Lancet* 2017, **389**(10064):119-124.

303. Fetene N, Linnander E, Fekadu B, Alemu H, Omer H, Canavan M, Smith J, Berman P, Bradley E: **The Ethiopian Health Extension Program and Variation in Health Systems Performance: What Matters?** *PloS one* 2016, **11**(5):e0156438.

304. Gebrehiwot TG, San Sebastian M, Edin K, Goicolea I: **The Health Extension Program and Its Association with Change in Utilization of Selected Maternal Health Services in Tigray Region, Ethiopia: A Segmented Linear Regression Analysis**. *PloS one* 2015, **10**(7):e0131195.

305. Workie NW, Ramana GN: **The Health Extension Program in Ethiopia**. In. Washington DC: The World Bank; 2013.

306. (UN) UN: **Transforming our world: the 2030 Agenda for Sustainable Development** In. New York, USA: United Nations; 2015.

307. Black MM, Hurley KM: **Early child development programmes: further evidence for action**. In. Baltimore, USA: Research Triangle Institute; 2016.

308. Walker SP, Chang SM, Vera-Hernández M, Grantham-McGregor S: **Early Childhood Stimulation Benefits Adult Competence and Reduces Violent Behavior**. *Pediatrics* 2011, **127**(5):849-857.

309. Urke HB, Contreras M, Matanda DJ: **The Influence of Maternal and Household Resources, and Parental Psychosocial Child Stimulation on Early Childhood Development: A Cross-Sectional Study of Children 36(-)59 Months in Honduras**. *International journal of environmental research and public health* 2018, **15**(5).

310. Shonkoff JP: **Science, Policy, and Practice: Three Cultures in Search of a Shared Mission**. *Child development* 2000, **71**(1):181-187.

CHAPTER 4: NEDERLANDSTALIGE SAMENVATTING

Wereldwijd leven 385 miljoen kinderen onder de 5 jaar in extreme armoede. De helft van deze kinderen bevindt zich momenteel in Sub-Sahara Afrika. Al deze kinderen lopen een groot risico om niet optimaal te ontwikkelen. De voornaamste riscofactoren zijn ondervoeding, gebrek aan zuiver water, behoorlijk sanitair, voldoende leeropportuniteiten en adequate zorg en stimulering thuis. Door intergenerationele transmissie van extreme armoede kunnen de risico's waaraan deze kinderen blootgesteld zijn ook doorgegeven worden naar de volgende generaties. Effectieve interventies zijn dus van vitaal belang om deze kinderen betere ontwikkelingsmogelijkheden te bieden en mogelijke intergenerationele invloeden te doorbreken. Het is duidelijk dat de specifieke problemen van dergelijke kinderen eerst moeten worden geïdentificeerd en gedocumenteerd, vooraleer interventies worden kunnen worden ontworpen en toegepast. In landen van de sub-Sahara, zoals Ethiopië, werd de omvang van ontwikkelingsproblemen bij dergelijke kinderen nog niet geïdentificeerd en dus ook niet gedocumenteerd. Het proefschrift bevat daarom 2 studies. Deze zijn voorafgegaan door een preliminaire studie die weliswaar werd gepubliceerd maar niet in het proefschrift werd opgenomen. In dit doctoraatsproefschrift wordt daarom in de eerste plaats een analyse gemaakt van de ontwikkelings-, voedings- en psychosociale problemen van jonge kinderen (3 tot 59 maanden oud; n=819) die leven in extreme armoede in ZW-Ethiopië. Vanuit deze analyse werd vervolgens een spel-gemedieerde stimulering bij hen thuis als interventie ontworpen en geïmplementeerd en op effectiviteit getest. Voor deze interventiestudie werd gekozen voor een 'randomized controlled trial' (RCT) met twee groepen, bestaande uit een interventie (n=39)- en een controle (n=39) groep. De kinderen in de beide

groepen kregen een pakket basiszorg (o.a. een thuis in gezinsverband, voedsel, kleren, gezondheidszorg, bescherming en educatie), en de kinderen in de interventiegroep kregen bovendien een spel-gemedieerd stimulatieprogramma aan huis. Zowel het pakket basiszorg als het stimulatieprogramma gingen gelijktijdig van start. De spel-gemedieerde stimulering werd gedurende 6 maanden wekelijks aan huis gegeven en nam telkens ongeveer een uur in beslag. De stimulering aan huis werd gegeven door ervaren en speciaal hiervoor opgeleide ziekenhuisverpleegsters in samenwerking met de primaire zorgverleners van de kinderen. Bij elk wekelijks thuisbezoek werd door de verpleegsters spelmateriaal meegebracht en achtergelaten voor de moeder en het kind om te oefenen. De interventie was vooral gericht op activiteiten die de ontwikkelingsvaardigheden van het kind bevorderen. Tegelijk werd ook de directe moeder-kind interactie gestimuleerd. Moeders werden regelmatig gesensibiliseerd en gemotiveerd om de aangeleerde activiteiten (samen met het cultuureigen spel) gedurende deze thuisbezoeken te oefenen en in praktijk te brengen. Voor dergelijke doelbewuste contextuele benadering van het kind binnen de interventie werd beroep gedaan op het WHO 'International Classification of Functioning, Disability and Health (ICF) model. De voorkeur aan thuis bezoeken en nauwe samenwerking met de primaire zorgverleners van de kinderen is gebaseerd op de overtuiging dat vooral hun interactie met de kinderen de ontwikkeling alsook het welzijn kunnen verbeteren. We gingen er ook vanuit dat meer aandacht voor de kinderopvoeding de kinderen ten goede komt op een meer duurzame manier. De ontwikkeling in persoonlijke-sociale vaardigheden, taal, fijne en grove motorische vaardigheden werden getest aan de hand van de cultuur aangepaste en gestandaardiseerde ontwikkeling

screenings test, de Denver II-Jimma. Sociaal-emotionele vaardigheden zoals o.a. zelfregulatie, emotie, adaptatief functioneren, compliantie, autonomie, interactie met mensen, communicatiegedrag) werden ingeschat aan de hand van de aangepaste 'Ages and Stages Questionnaire: Social-Emotional (ASQ: SE)'. Psychosociale contextuele en sociodemografische gegevens werden verzameld aan de hand van een gestructureerde vragenlijst. Antropometrische meetmethoden warden gebruikt om de voedingsstatus van het kind te bepalen. De resultaten van de eerste onderzoekstudie (**Studie 1, Hoofdstuk 2**) tonen aan dat kinderen in extreme armoede (n=819) slechter presteren in alle ontwikkelingsparameters (taal, grove en fijne motorische vaardigheden, persoonlijke sociale vaardigheden, sociaal-emotionele vaardigheden) dan referentiekinderen) van dezelfde leeftijd. Daarnaast ervaren zij ook meer psychosociale problemen, wat zich reflecteert in een beperking van de kind-kind interactie ($\chi^2 = 90.7$, $p<0.001$), moeder-kind interactie ($\chi^2 = 116.1$, $p<0.001$), spelmateriaal ($\chi^2 = 243$, $p<0.001$), speelpleinen ($\chi^2 = 194.2$, $p<0.001$) en speeltijd ($\chi^2 = 12.8$, $p<0.001$). Binnen de groep van de kinderen in extreme armoede lijdt 39.7% aan dwerggroei, 16.5% aan ondergewicht en is 3.3% te mager voor hun lengte. Dwerggroei op zich blijkt negatief geassocieerd met alle ontwikkelingsparameters. Na uitsluiting van het effect van dwerggroei, blijkt ook dat de beperking in spelactiviteiten, in kind-kind interacties en moeder-kind relaties negatief geassocieerd is met taal en grove motorische vaardigheden. Vanuit de resultaten van de interventiestudie (**Studie 2, Hoofdstuk 2**) blijken de kinderen uit de interventiegroep al na 3 maanden (mid-test) spel-gemedieerde interventie aan huis vooruitgang te boeken op vlak van taal ($P=0.0151$, effect grootte (es) = 0.34) en sociaal-emotionele vaardigheden

(P<0.0001, es = -0.603). Het negatief teken (-) van de effect grootte (es) wijst op een afname in de socio-emotionele problemen. Na 6 maanden (eindtest) interventie werd een significante verbetering voor taal (P=0.0014, effect grootte (es) = 0.55), persoonlijke-sociale (P=0.0087, es = 0.56) en sociaal-emotionele (P<0.0001, es = -1.28) vaardigheden waargenomen. Voor taal hing het interventie-effect af van het geslacht van het kind (P=0.0100): jongens haalden meer voordeel uit de interventie dan meisjes. De conclusie van dit doctoraatsonderzoek is dat kinderen uit extreem armoedige huishoudens niet enkel ondervoed zijn maar ook sterker psychosociale problemen ervaren. Beide problemen blijken onafhankelijk hun ontwikkeling te beïnvloeden. Het onderzoek toont aan dat een kwaliteitsvolle spel-gemedieerde stimulering aan huis de ontwikkeling van deze kinderen onder de vijf jaar bevordert. Op basis van deze resultaten wordt voorgesteld dit type interventie op nationaal vlak te implementeren.

APPENDICES

Appendix: Multiple regression analysis (Overall F-tests)

Appendix A: Relationships of nutritional status/psychosocial factors with Denver II-Jimma's developmental domains

Multiple linear regression tries to fit a regression line for a response (dependent) variable using more than one explanatory variable. And, analysis of variance (ANOVA) forms a foundation for tests of significance. Accordingly, an F-test in regression compares the fits of different linear models. Unlike t-test that can assess only one regression coefficient at a time, the F-test can evaluate multiple coefficients simultaneously. If the p-value of the overall F-test is significant, the regression model predicts the response variable better than the mean of the response.

F-tests of overall significance in regression analysis were conducted for Denver II developmental domains (dependent variables: personal-social, fine motor, language and gross motor), separately. The predictor variables were stunting, underweight, child-child interaction, caregiver-child interaction, access to play materials and playground. These explanatory or independent variables were used in their binary forms (absence or presence, i.e. 0, 1). The details are presented in the Table below.

Appendix: Multiple regression analysis (Overall F-tests)

Table F-test in multiple linear regression analysis for developmental domains

Predictors	Outcomes	F	P-value
Stunting Under weight	**Personal-social**	9.716	0.001
Stunting Underweight Access to playground	**Fine motor**	11.330	0.001
Stunting Underweight Child-child interaction Caregiver-child interaction Access to play materials Access to playground	**Language**	11.527	0.001
Stunting Underweight Child-child interaction Caregiver-child interaction	**Gross motor**	30.305	0.001

Appendix B: Child and caregiver characteristics of foster and reference children

Child and caregiver variables of foster and reference children, at baseline, are presented in Table below. Tests for continuous variables were conducted using independent samples t-test; where as tests for categorical variables were conducted with pearson's chi-square.

Table Child and caregiver characteristics of the foster children and age-& gender-matched reference children (N = 156)

Variables	Foster (n=78)	Reference (n=78)	p-value
Child variables			
Age (in months)	20.9 (14.7)	20.9 (14.6)	0.991
Girls	36 (46.2%)	36 (46.2%)	0.949
Language performance	17.72 (8.89)	21.72 (10.62)	0.012*
Personal-social performance	14.32 (6.28)	15.26(6.91)	0.377
Fine motor performance	16.65 (5.90)	17.99 (7.09)	0.204
Gross motor performance	18.77 (7.56)	21.46 (8.90)	0.043*
Social-emotional performance	48.78 (21.06)	39.19 (19.98)	0.004*
WHZ	0.04 (1.52)	1.02 (1.71)	<0.001*
HAZ	-1.26 (1.49)	-0.88 (2.20)	0.213
WAZ	-0.64 (1.23)	0.20 (1.29)	<0.001*
Caregiver variables			
Age (≤30 years)	38 (48.70%)	41(52.60%)	0.631
Education (Illiterate or ≤ grade 8)	60 (76.90%)	32 (41.00%)	<.001*
Occupation (house maid)	61 (78.20%)	19 (24.40%)	<0.001

Appendix: Foster vs reference children's outcomes compared

Note. Chi-square test: n (%) and p-value, t-test: mean (SD) and p-value, were performed depending on the level of measurement of the data.

Appendix C. 1: Information Sheet

Dear Caregiver,

As part of Interuniversity' cooperation between Jimma University and group of universities in Belgium (VLIR: IUC-JU), we are planning to conduct a research on the developmental and nutritional status of children living in extreme poverty in Jimma town. The study will use culturally appropriate play-based stimulation techniques, at home-settings. In doing so, we look into how children interact with people and play with objects in their daily life. Our focus is on children of 3 months through five years of age. We provide them some play materials and see how they manipulate the objects under the instruction of trained professionals and in the presence of you (the caregiver). In order to get certain information about the child, a caregiver familiar with the child is needed. Hence, we kindly request you to cooperate with us in allowing us to involve your child in our study by availing yourself during the 60 minutes of the play and skills transfer session. The sessions will be conducted by trained nurses with your child and you. Your presence will be very important because you will provide us some relevant information about the child and the child will feel comfortable with you around. The study provides information on how play activities and evidence-based parenting skills may help child development. It also helps to design appropriate program that parents and organizations working with children in difficult circumstances can use to enhance healthy child development and growth.

We assure you that there is no harm on you and your child for taking part in this study. Yet, you and your child have the full right not to participate in

this study if you do not want to. Your cooperation, on the other hand, contributes much in providing information that will be used for the betterment of children's life. If you agree to take part in the study, please put your name and signature on the space provided below.

Name of caregiver	Signature	Date
----------	----------	----------

Thank you for your cooperation!

Berhanu Nigussie Worku

Study team leader, Jimma University

Appendix: Information sheet

Appendix C. 2: Waliigaltee/Eeyyama Guddiftuu fi Ibsa Gabaabaa

Kabajamoo Guddiftuu,

Yuunivarsiitiin Jimmaa qorannoowwan rakkoolee hawaasaa gidugaleessa godhatan gaggeessaa jira. Kana keessaa qorannoon guddina fi dagaagina daa'immanniirratti godhamu isa tokkodha. Qorannichi ijoolleen hiyyuummaa cimaa keessaa jiraatan umuriisaaniin walqabatee wantoota isaan raawwachuu danda'an addabaasanii baruudhaan deeggarsa umuriisaaniin madaalame kennufiif jecha kan gaggeeffamu yammuu ta'u argannoon qorannichaa odeeffannoo barbaachisoo ogeessota fayyaaf, maatiidhaa (guddistoota) fi barsiisotaaf kennuuf ni gargaara.

Qorannoo kana keessatti kan qooda fudhatan daa'imman hiyyuummaa hamaa keessaa jiraatan umuriin isaanii ji'a 3 hanga wagaa 5 ta'an fi guddiftoota isaanii waan ta'eef qorannoo kanaaf isinii fi mucaan keessan filatamtaniittu. Kanaaf jecha, akka isin nuu eeyyamtan kabajaan isin gaafanna.

Oddeeffannoon kan funaanamu gara mana keessanii kan dhufan dubartoota ogeessota fayyaa /neersota ta'aniin. Odeeffannoo argachuuf wanti yaaliidhaaf jedhamee mucaarraa fudhamu (FKN, dhiigni, booliin) tokkollee kan hin jirre yammuu ta'u mucaan umurii isaatiin/isheetiin mal akka raawwachuu danda'u/dandeessu beekuudhaaf haala taphaatiin wantoota raawwataman itti kennuudhaan, isiniin gaafachuudhaan, daawwachuudhaan, hojaa fi ulfina isaa/ishee safaruudhaan ta'a.

Odeeffannoon kan funaanamu magaala Jimmaa irraati. Kanaaf jecha, yoo qorannoo kana keessatti qooda fudhachuun odeeffannoo nuuf kennuuf

Appendix: Information sheet

hayyamtan bakka duwwaa gaditti argamurratti maqaa keessanii fi mallattoo keessan barreessuudhaan akka nuuf mirkaneessitan kabajaan isin gaafanna.

Maaqaa	Mallattooo	Guyyaaa
_____	_____	_____

Hirmaannaa keessaniif dursinee isin galateeffanna!

Birahaanuu Nugussee Warquu

Dursaa garee qoranichaa, Yuunivarsiitii Jimmaa

Appendix: Consent form

Appendix D. 1: Consent form for developmental stimulation study of children in extremely poverty

I, the undersigned, understand that the purpose of this study is to take some measurements of my child, perform some play-based stimulation to my child and gather some relevant information, from me, about my child. I am aware that the measurements and information to be collected about the child will enable us to acquire information about the developmental and nutritional status of the child at different age levels and to use this information for the better life of the child and many more children in Ethiopia.

I have been informed that there will be no health hazards or discomfort to my child associated with this, and that my participation is voluntary. I also know that I am free to withdraw from the study at any time in point without any explanation. I further understand that all of the data gathered are kept confidential and I agree to allow publication of any or all of the data collected on my child if presented in a coded form.

Caregiver's Name Signature Date

_____ _____ _____

Appendix: Consent form

Appendix D. 2: Boca Waliigaltee (Eeyyamummaa) Qo'annoo Dadamaqina Dagaagina Daa'imman Hiyyuummaa Cimaa Keessaa Jiranii

Ani, maqaa fi mallattoon koo gaddi tti kan argamu, qo'annooni kuni mucaan koo umuriisaatiin wantanni hojjechuu danda'u baruudhaaf hojjaa fi ulfaatina isaa/ishee dabalee haala taphaatiin wantoota inni/isheen raawwachuu danda'u/dandeessu safaruuf akka ta'e nan hubadha. Safara kana gaggeessuudhaan odeeffannoo maatiin, ogeessotni fayyaa fi barsiisotni itti fayyadamanii tajaajila barbaachisaa ta'e haala umurii daa'immannii ilaalcha keessa galcheen kennaniif kan gargaaru ta'uu isaa nan hubadha. Safara kana geggeessuun fayyummaa mucaa koorratti dhiibbaa tokko akka hin qabne fi qoodafudhachuun dirqama tokko malee ta'uunsaas naaf ibsameera.

Safarri kun bakka ani jirutti akka geggeeffamu fi odeeffannoon argamu hiccitiin kan eegamu akka ta'e kan naaf ibsame yammuu ta'u, haala maqaa mucaa kootii hin ibsineen mallattoo/koodii fayyadamuudhaan odeeffannoo funaanamu maxxansiisuun akka danda'amu eeyyammeera.

Maqaa Guddiftuu	Mallattoo	Guyyaa
_____	_____	_____

Appendix: Questionnaire used to collect psychosocial and sociodemographic characteristics

---

Appendix E: Questionnaire for psychosocial conditions and socio-demographic characteristics

Date of today: ---------- Code for respondent/caregiver ----------

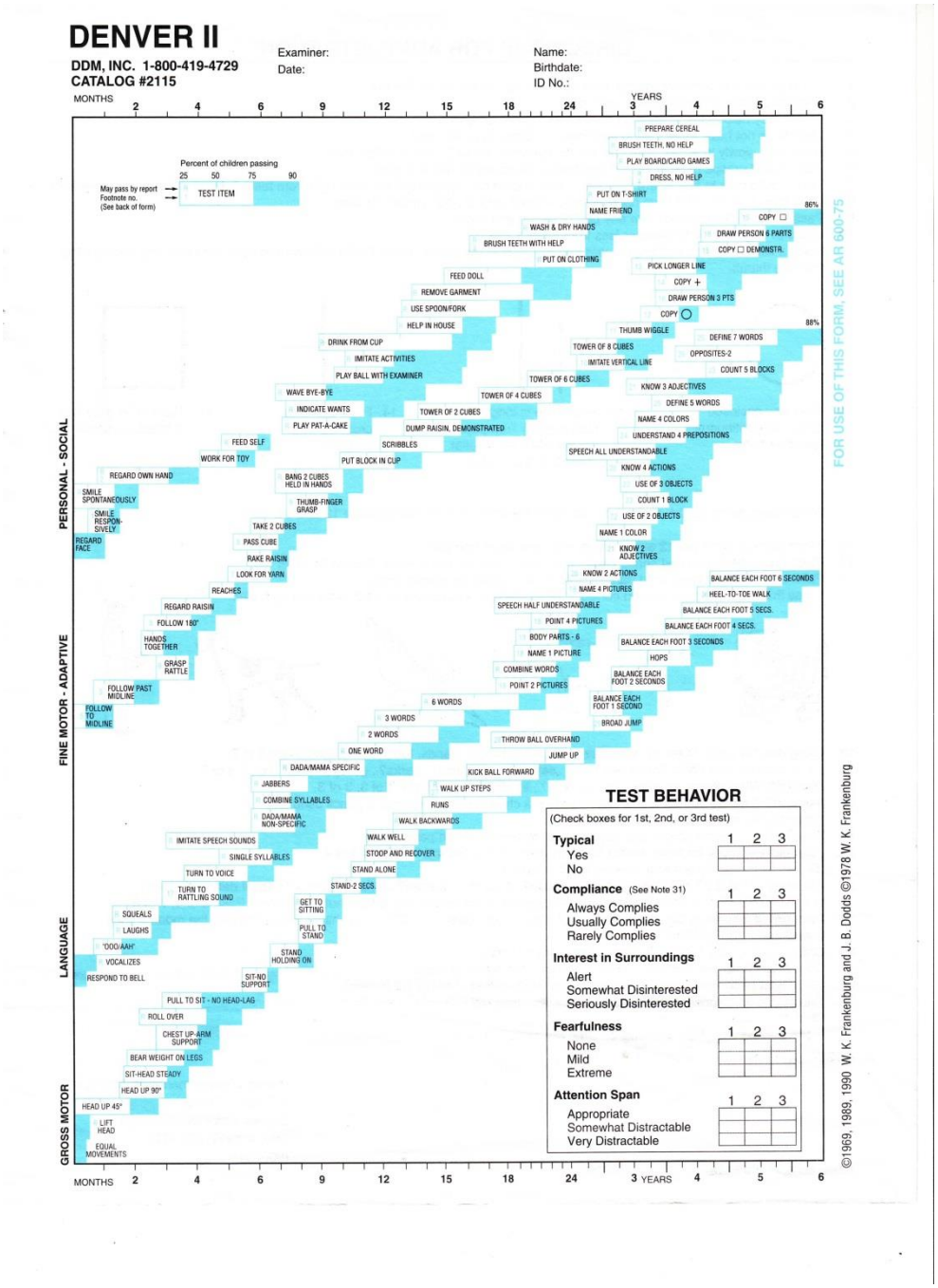
Residential address: woreda/district ----------Kebele----------Garee-----
Gooti: ---------- House Number---------- Special name of the place: ----------

		A	B	C	D	E	F.	G	H
1	Age of a caregiver: ----------	less than 20 yr ☐	20-30 yr ☐	31-40 yr ☐	*above 41 yrs* ☐				
2	Caregiver's religion	Islam ☐	Orthodox Christian ☐	protestant christian ☐	traditional religion ☐	Catholic ☐	other ☐		
3	Education level of a caregiver	illiterate ☐	grade 1-8 ☐	grade 9-12 ☐	certificate ☐	diploma ☐	degree & above ☐		
4	Occupation of a caregiver ----------	house wife ☐	teacher ☐	office worker ☐	On street merchant ☐	Field work ☐	Traditional farm ☐	Trade ☐	other ☐
5	Ethnicity of a carever ----------	Oromo ☐ Amhara ☐	Tigre ☐ Gurage ☐	Silte ☐	Dawuro ☐	Yem ☐	Kefich ☐	Welayita ☐	othe ☐
6	Monthly income of a household ----------	less than 500 birr ☐	500-1500 birr ☐	1501-3500 birr ☐	above 3500 birr ☐				
7	Age of a child: ----------								
8	Sex of a child	Girl ☐	Boy ☐						
9	*Birth order of achild*	first born ☐	2nd born ☐	*3rd born* ☐	*between 3rd and last born child* ☐	*last born* ☐			
10	Schooling of a child	not started schooling ☐	nursery ☐	KG1 ☐	KG2 ☐	KG3 ☐			
11	Family size ----------	*less than 3* ☐	*3-6* ☐	*7-10* ☐	*above 10* ☐				

Appendix: Questionnaire used to collect psychosocial and sociodemographic characteristics

12	Number of children the child meets in neighbor: ----------	*less than 3* ☐	*3-6* ☐	*7-10* ☐	*above 10* ☐				
13	Frequency of the child's interaction with other children	always ☐	sometimes ☐	*never interacts with others* ☐					
14	Caregiver-child interaction time	during feeding and toileting ☐	out of working hours ☐	always together ☐					
15	Availability of play materials	yes	no						
16	Availability of playground	yes	no						

Appendix F: Denver II test form



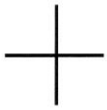
Appendix: Denver II test form

DIRECTIONS FOR ADMINISTRATION

1. Try to get child to smile by smiling, talking or waving. Do not touch him/her.
2. Child must stare at hand several seconds.
3. Parent may help guide toothbrush and put toothpaste on brush.
4. Child does not have to be able to tie shoes or button/zip in the back.
5. Move yarn slowly in an arc from one side to the other, about 8" above child's face.
6. Pass if child grasps rattle when it is touched to the backs or tips of fingers.
7. Pass if child tries to see where yarn went. Yarn should be dropped quickly from sight from tester's hand without arm movement.
8. Child must transfer cube from hand to hand without help of body, mouth, or table.
9. Pass if child picks up raisin with any part of thumb and finger.
10. Line can vary only 30 degrees or less from tester's line. /
11. Make a fist with thumb pointing upward and wiggle only the thumb. Pass if child imitates and does not move any fingers other than the thumb.

12. Pass any enclosed form. Fail continuous round motions.

13. Which line is longer? (Not bigger.) Turn paper upside down and repeat. (pass 3 of 3 or 5 of 6)

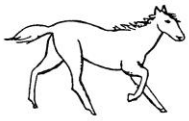


14. Pass any lines crossing near midpoint.

15. Have child copy first. If failed, demonstrate.

When giving items 12, 14, and 15, do not name the forms. Do not demonstrate 12 and 14.

16. When scoring, each pair (2 arms, 2 legs, etc.) counts as one part.
17. Place one cube in cup and shake gently near child's ear, but out of sight. Repeat for other ear.
18. Point to picture and have child name it. (No credit is given for sounds only.)
    If less than 4 pictures are named correctly, have child point to picture as each is named by tester.


19. Using doll, tell child: Show me the nose, eyes, ears, mouth, hands, feet, tummy, hair. Pass 6 of 8.
20. Using pictures, ask child: Which one flies?...says meow?...talks?...barks?...gallops? Pass 2 of 5, 4 of 5.
21. Ask child: What do you do when you are cold?...tired?...hungry? Pass 2 of 3, 3 of 3.
22. Ask child: What do you do with a cup? What is a chair used for? What is a pencil used for? Action words must be included in answers.
23. Pass if child correctly places and says how many blocks are on paper. (1,5).
24. Tell child: Put block **on** table; **under** table; **in front of** me, **behind** me. Pass 4 of 4. (Do not help child by pointing, moving head or eyes.)
25. Ask child: What is a ball?...lake?...desk?...house?...banana?...curtain?...fence?...ceiling? Pass if defined in terms of use, shape, what it is made of, or general category (such as banana is fruit, not just yellow). Pass 5 of 8, 7 of 8.
26. Ask child: If a horse is big, a mouse is ___? If fire is hot, ice is ___? If the sun shines during the day, the moon shines during the ___? Pass 2 of 3.
27. Child may use wall or rail only, not person. May not crawl.
28. Child must throw ball overhand 3 feet to within arm's reach of tester.
29. Child must perform standing broad jump over width of test sheet (8 1/2 inches).
30. Tell child to walk forward, heel within 1 inch of toe. Tester may demonstrate. Child must walk 4 consecutive steps.
31. In the second year, half of normal children are non-compliant.

OBSERVATIONS:

Denver Developmental Materials, Inc.
P.O. Box 371075
Denver, Colorado 80237-5075
Tele. #: (303) 355-4729
(800) 419-4729

Catalog #2115 **TO REORDER CALL: (800) 419-4729**

Appendix: 60 Month ASQ: SE Questionnaire (as a sample)

Appendix G: ASQ: SE (the 60 Month Questionnaire as an example)

Ages & Stages Questionnaires®: Social-Emotional
A Parent-Completed, Child-Monitoring System for Social-Emotional Behaviors
By **Jane Squires, Diane Bricker, & Elizabeth Twombly**
with assistance from **Suzanne Yockelson, Maura Schoen Davis, & Younghee Kim**

ASQ:SE™

60 Month/5 Year Questionnaire

(For children ages 54 through 65 months)

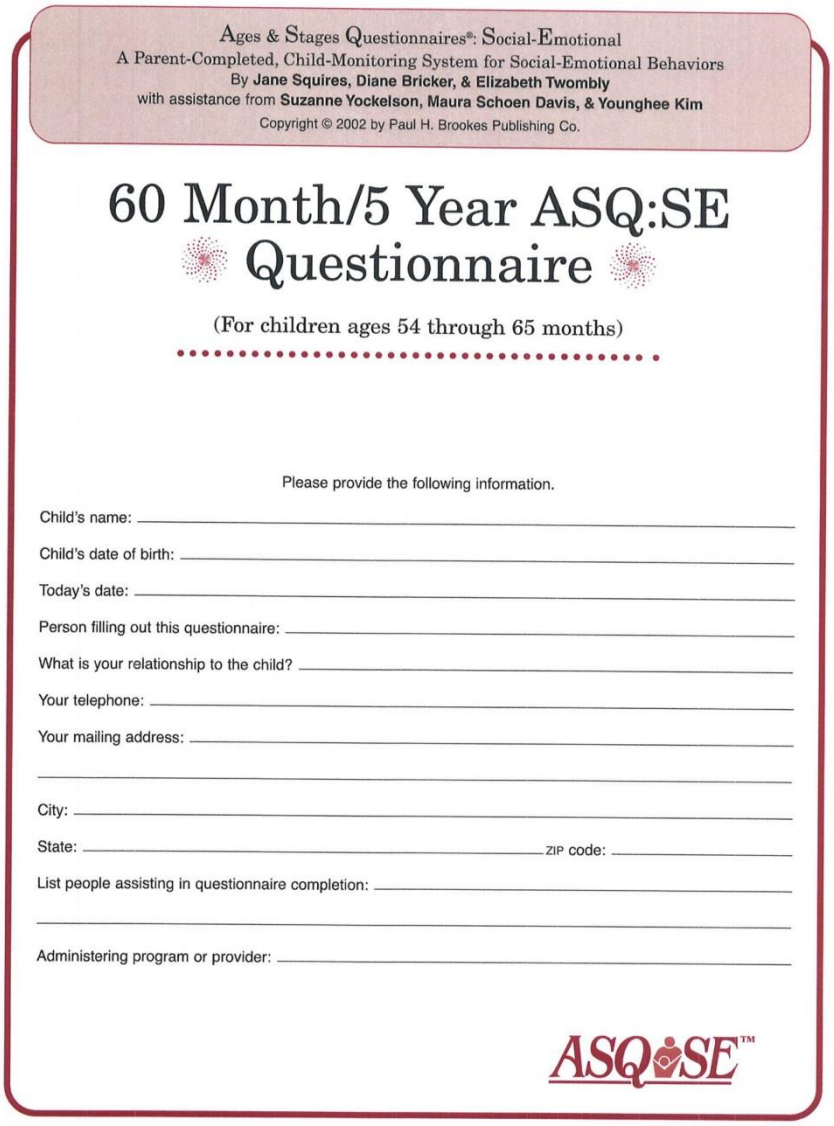
Important Points to Remember:

- ☑ Please return this questionnaire by _____ .
- ☑ If you have any questions or concerns about your child or about this questionnaire, please call: _____ .
- ☑ Thank you for your participation in this project.

ASQ:SE™

1

Appendix: 60 Month ASQ: SE Questionnaire (as a sample)



Ages & Stages Questionnaires®: Social-Emotional
A Parent-Completed, Child-Monitoring System for Social-Emotional Behaviors
By **Jane Squires, Diane Bricker, & Elizabeth Twombly**
with assistance from **Suzanne Yockelson, Maura Schoen Davis, & Younghee Kim**

60 Month/5 Year ASQ:SE Questionnaire

(For children ages 54 through 65 months)

Please provide the following information.

Child's name: _____

Child's date of birth: _____

Today's date: _____

Person filling out this questionnaire: _____

What is your relationship to the child? _____

Your telephone: _____

Your mailing address: _____

_____

City: _____

State: _____ ZIP code: _____

List people assisting in questionnaire completion: _____

_____

Administering program or provider: _____

ASQ:SE™

2

Appendix: 60 Month ASQ: SE Questionnaire (as a sample)

Please read each question carefully and 1. Check the box ❑ that best describes your child's behavior *and* 2. Check the circle ❍ if this behavior is a concern	MOST OF THE TIME	SOMETIMES	RARELY OR NEVER	CHECK IF THIS IS A CONCERN
1. Does your child look at you when you talk to her?	❑ z	❑ v	❑ x	❍
2. Does your child cling to you more than you expect?	❑ x	❑ v	❑ z	❍
3. Does your child like to be hugged or cuddled?	❑ z	❑ v	❑ x	❍
4. Does your child talk and/or play with adults he knows well?	❑ z	❑ v	❑ x	❍
5. When upset, can your child calm down within 15 minutes?	❑ z	❑ v	❑ x	❍
6. Does your child seem too friendly with strangers?	❑ x	❑ v	❑ z	❍
7. Can your child settle herself down after periods of exciting activity?	❑ z	❑ v	❑ x	❍
8. Does your child seem happy?	❑ z	❑ v	❑ x	❍
9. Does your child cry, scream, or have tantrums for long periods of time?	❑ x	❑ v	❑ z	❍

TOTAL POINTS ON PAGE ___

Appendix: 60 Month ASQ: SE Questionnaire (as a sample)

		MOST OF THE TIME	SOMETIMES	RARELY OR NEVER	CHECK IF THIS IS A CONCERN
10. Is your child interested in things around him, such as people, toys, and foods?		❑ z	❑ v	❑ x	○
11. Does your child go to the bathroom by herself? (Reminders and help with wiping are okay.)		❑ z	❑ v	❑ x	○
12. Does your child have eating problems, such as stuffing foods, vomiting, eating nonfood items, or _____ ? (You may write in another problem.)		❑ x	❑ v	❑ z	○
13. Can your child stay with activities he enjoys for at least 15 minutes (not including watching television)?		❑ z	❑ v	❑ x	○
14. Do you and your child enjoy mealtimes together?		❑ z	❑ v	❑ x	○
15. Does your child do what you ask her to do?		❑ z	❑ v	❑ x	○
16. Does your child seem more active than other children his age?		❑ x	❑ v	❑ z	○
17. Does your child sleep at least 8 hours in a 24-hour period?		❑ z	❑ v	❑ x	○

TOTAL POINTS ON PAGE ___

Appendix: 60 Month ASQ: SE Questionnaire (as a sample)

	MOST OF THE TIME	SOMETIMES	RARELY OR NEVER	CHECK IF THIS IS A CONCERN
18. Does your child use words to tell you what she wants or needs?	❑ z	❑ v	❑ x	○
19. Does your child use words to describe his feelings and the feelings of others, such as, "I'm happy," "I don't like that," or "She's sad"?	❑ z	❑ v	❑ x	○
20. Does your child move from one activity to the next with little difficulty, such as from playtime to mealtime?	❑ z	❑ v	❑ x	○
21. Does your child explore new places, such as a park or a friend's home?	❑ z	❑ v	❑ x	○
22. Does your child do things over and over and can't seem to stop? Examples are rocking, hand flapping, spinning, or _____. (You may write in something else.)	❑ x	❑ v	❑ z	○
23. Does your child hurt herself on purpose?	❑ x	❑ v	❑ z	○
24. Does your child follow rules (at home, at child care)?	❑ z	❑ v	❑ x	○
25. Does your child destroy or damage things on purpose?	❑ x	❑ v	❑ z	○

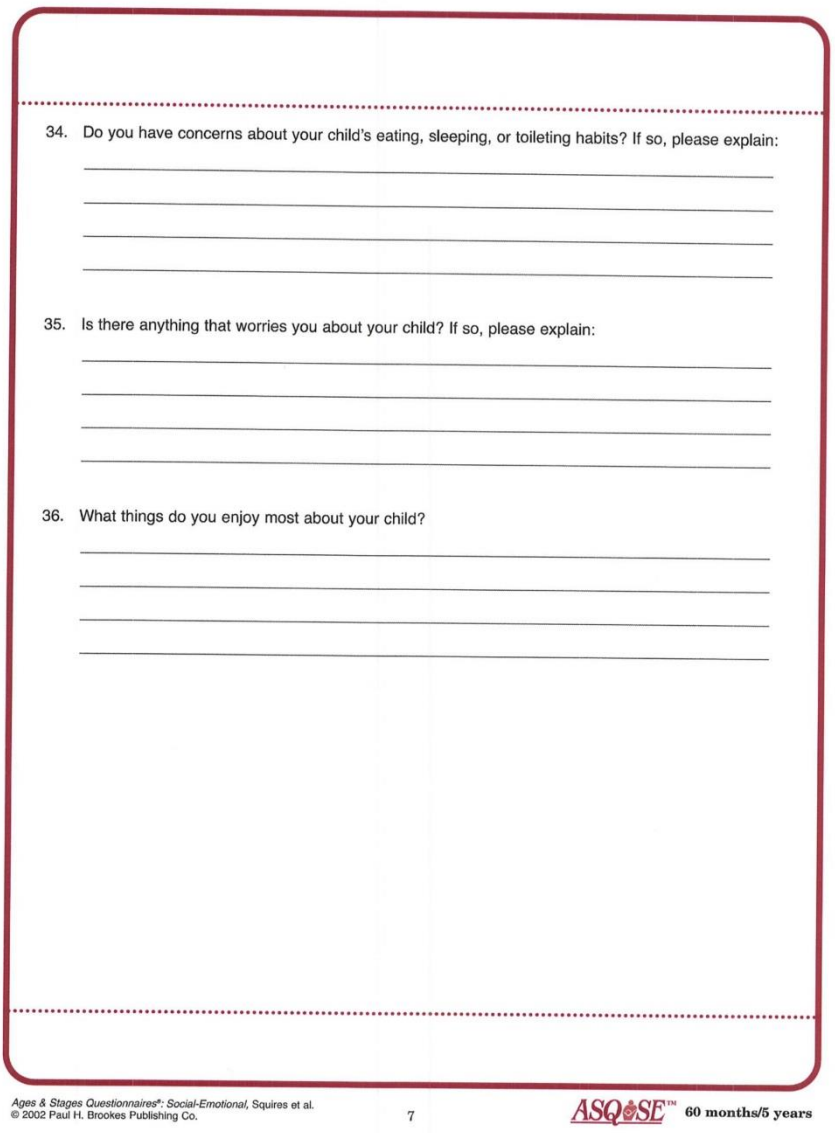
TOTAL POINTS ON PAGE ___

Appendix: 60 Month ASQ: SE Questionnaire (as a sample)

	MOST OF THE TIME	SOMETIMES	RARELY OR NEVER	CHECK IF THIS IS A CONCERN
26. Does your child stay away from dangerous things, such as fire and moving cars?	❑ z	❑ v	❑ x	○
27. Does your child show concern for other people's feelings? For example, does he look sad when someone is hurt?	❑ z	❑ v	❑ x	○
28. Do *other* children like to play with your child?	❑ z	❑ v	❑ x	○
29. Does *your child* like to play with other children?	❑ z	❑ v	❑ x	○
30. Does your child try to hurt other children, adults, or animals (for example, by kicking or biting)?	❑ x	❑ v	❑ z	○
31. Does your child take turns and share when playing with other children?	❑ z	❑ v	❑ x	○
32. Does your child show an interest or knowledge of adult sexual language and activity?	❑ x	❑ v	❑ z	○
33. Has anyone expressed concerns about your child's behaviors? If you checked "sometimes" or "most of the time," please explain: _____ _____ _____ _____	❑ x	❑ v	❑ z	○

TOTAL POINTS ON PAGE ___

Appendix: 60 Month ASQ: SE Questionnaire (as a sample)



34. Do you have concerns about your child's eating, sleeping, or toileting habits? If so, please explain:

35. Is there anything that worries you about your child? If so, please explain:

36. What things do you enjoy most about your child?

Appendix H: Dataset description

Table Data Line: data collected per child

Tools	No of items	Outcomes	Outcome form
Denver-II Jimma		Development	Performance score &
Personal-social	25		Performance ratio
Fine motor	29		
Language	39		
Gross motor	32		
ASQ:SE (Social-emotional)		Development	Performance score
3-8 months	22		

9-14 months	23		
15-20 months	29		
21-26 months	29		
27-32 months	32		
33-41 months	34		
42-53 months	36		
54-65 months	36		
Anthropometry		Nutritional status	Binary (Yes/No)
Weighing scale	1	WAZ	
Stadiometeter or	1	HAZ or	

Length measuring mat	1	LAZ	
		WHZ/WLZ	
Questionnaire	16		Binary & continuous
Questions about caregivers		Caregiver variables	
Questions about children		Psychosocial variables	
		(E.g. Child-child interaction,	
		Caregiver-child interaction	
		Play materials	
		Playground	
		Play time)	

Appendix: Description of the dataset per child

Note. ASQ: SE: Ages and Stages Questionnaires: Social-Emotional, WAZ: weight-for-age z score, HAZ: height-for-age z score, LAZ: length-for-age z score, WHZ: weight-for-height z score, WLZ: weight-for-length z score. The z-score, used to express the anthropometric indicators or nutritional status, was calculated using the WHO's Anthro software. In addition, based on the WHO's Child Growth Standard, underweight, wasting and stunting were defined as WAZ, WHZ/WLZ and HAZ/LAZ below -2SD respectively. For the purpose of analysis, these nutritional status (underweight, wasting and stunting) were made binary: e.g. being underweight (Yes/No), wasted (Yes/No) and stunted (Yes/No).

CURRICULUM VITAE

Berhanu Nigussie Worku was born on 5th of May 1983 in 'Burqaa-Caffee', Selale, Ethiopia. In 2005, he graduated in Educational Psychology with Bachelor of Arts (BA) degree from Addis Ababa University, Ethiopia. In 2006, he was employed by an international NGO called Italian Center for Aids to Children or Centro Italiano Aiuti All'infanzia (CIAI) and worked as a psychologist for one year. In 2008, he obtained his Master of Arts (MA) degree in Psychology from Addis Ababa University again. In the same year, he was awarded postgraduate diploma in child and adolescent play therapy, filial play coaching and clinical supervision by Play Therapy International (PTI). In September 2008, he joined the department of psychology in Jimma University as a lecturer. From 2009-2014, he served as Academic and Research Quality Assurance Coordinator in the College of Social Sciences and Law. In 2011, he participated in a 'Graduate Tracer Study' conducted at national level by Jimma University. In December 2013, he won a scholarship and participated in a week long seminar entitled "Building Sustainable Research in Child and Adolescent Mental Health in Africa," conducted in South Africa. In January 2013, he was promoted to the rank of Assistant Professor. In May 2013, Berhanu got registered as a PhD student, in a sandwich program, at the Faculty of Medicine and Life Sciences in REVAL Research Institute, Rehabilitation Sciences and Physiotherapy under the supervision of Prof. dr. Marita Granitzer. In April 2016, Berhanu was promoted to Associate Professorship by the Senate of Jimma University. In February 2018, he was awarded Masters of Sciences (MSc) degree in Positive and Transcultural Psychotherapy by International Academy for Positive and Transcultural Psychotherapy (IAPP). Currently, he is the coordinator of Research &

Postgraduate Studies (RPGS) at the College of Education and Behavioral Sciences in Jimma University, Ethiopia.

Publications

From this PhD project

Worku BN, Abessa TG, Wondafrash M, Vanvuchelen M, Bruckers L, Kolsteren P and Granitzer M: The relationship of undernutrition/psychosocial factors and developmental outcomes of children in extreme poverty in Ethiopia. BMC Pediatrics (2018) 18:45.

Worku BN, Abessa TG, Wondafrash M, Lemmens J, Valy J, Bruckers L, Kolsteren P and Granitzer M: Effects of home-based play-assisted stimulation on developmental performances of children living in extreme poverty: a randomized single-blind controlled trial. BMC Paediatrics (2018) 18:29.

Worku BN, Abessa TG, Franssen E, Vanvuchelen M, Kolsteren P & Granitzer M: Development, Social-Emotional Behavior and Resilience of Orphaned Children in a Family-Oriented Setting. J Child Fam Stud (2018) 27:465–474.

From joint projects

Argaw A, Huybregts L, Wondafrash M, Kolsteren P, Belachew T, **Worku BN**, Abessa TG & Bouckaert KP : Neither n-3 long-chain PUFA supplementation of mothers through lactation nor of offspring in a complementary food affects child overall or social-emotional development: a 2 x 2 factorial randomized controlled trial in rural Ethiopia. The Journal of Nutrition (2018); 148:1-8.

Abessa TG, **Worku BN**, Kibebew MW, Valy J, Lemmens J, Thijs H, Yimer WK, Kolsteren P, Granitzer M: Adaptation and standardization of a Western tool for assessing child development in non-Western low-income context. BMC Public Health 2016, 16(652); 1-13.

Abessa TG, **Worku BN**, Kibebew MW, Girma T, Valy J, Lemmens J, Bruckers L, Kolsteren P, Granitzer M: Effect of play-based family-centered psychomotor/psychosocial stimulation on the development of severely acutely malnourished children under six in a low-income setting: a randomized controlled trial. BMC Pediatrics. Under review.

Abstracts of presentations

Worku BN, Abessa TG, Wondafrash M, Valy J, Lemmens J, Bruckers L, Kolsteren P & Granitzer M, (2018). Interrupting the cycle of poverty and ensuring sustainable development through early interventions. The 9th annual research conference of Jimma University, April 26-27, 2018, Jimma, Ethiopia.

Safari WC, **Worku BN**, Abessa TG, Bruckers L, Granitzer M, (2017). Cluster Analysis of Ethiopian children (6-60 months of age) living in extreme poverty in Jimma town of Ethiopia using Denver-II subscales. The 6th Conference of the International Society for Child Indicators, June 28-30, 2017, Montreal, Quebec, Canada.

Worku BN, Abessa TG, Bruckers L, Kolsteren P & Granitzer M, (2017). Limited psychosocial stimulation and nutritional problems as associates of developmental performances of children in extreme poverty in Jimma, Ethiopia. International Conference on Child's Health & Development: Improving Children's Lives, Maximizing their abilities, June 08-09, 2017, Kathmandu, Nepal.

Worku BN, Abessa TG, Bruckers L, Kolsteren P & Granitzer M, (2017). Developmental performances and nutritional status of SOS children under 6 years of age in Jimma, Ethiopia. International Conference on Child's Health & Development: Improving Children's Lives, Maximizing their abilities, June 8-9, 2017, Kathmandu, Nepal.

Worku BN & Shiferaw S, (2014). Trends and Factors of Mental Illness: The Case of Psychiatry Ward in Jimma University Specialized Hospital, Ethiopia. In: Rey, Joseph M. (Ed.). IACAPAP 21st World Congress Abstracts, p. 135. Journal of Child & Adolescent Mental Health, 39.

Worku BN, (2014). Play Therapy as a self-healing and life-skills enhancing tool for children under problematic situations: Two orphanages in Addis Ababa (Ethiopia) in focus. In: Rey, Joseph M. (Ed.). IACAPAP 21st World Congress Abstracts, p. 135-136. Journal of Child & Adolescent Mental Health, 39.

Oral presentations

Worku BN, (2018). Interrupting the cycle of poverty and ensuring sustainable development through early interventions. The 9th annual research conference of Jimma University, April 26-27, 2018, Jimma, Ethiopia.

Worku BN, (2017). Limited psychosocial stimulation and nutritional problems as associates of developmental performances of children in extreme poverty in Jimma, Ethiopia. In: International Conference on Child's Health & Development: Improving Children's Lives, Maximizing their abilities, June 08-09, 2017, Kathmandu, Nepal.

Worku BN, (2014). Effective parenting skills for Ethiopian parents and caregivers: Important, but Overlooked Business. The 5th Annual Research Conference of Jimma University, Feb. 6 - 7, 2014, Jimma, Ethiopia.

Worku BN, (2013). The overwhelming consequences of child sexual abuse on the survivors. The 4th Annual Research Conference of Jimma University, Feb. 7 - 8, 2013, Jimma, Ethiopia.

Selected poster presentations

Abessa TG, **Worku BN**, Wondafrash M, Girma T, Valy J, Lemmens J, Bruckers L, Kolsteren P & Granitzer M, (2017). The effect of play-based family-centered psychomotor/psychosocial stimulation on the recovery of severely malnourished children in Ethiopia. International Conference on Child's Health and Development: Improving Children's Lives, Maximizing their Abilities, 8-9 June 2017, Kathmandu, Nepal.

Worku BN, Abessa TG, Bruckers L, Kolsteren P & Granitzer M, (2017). Developmental performances and nutritional status of SOS children under 6 years of age in Jimma, Ethiopia. In: International Conference on Child's Health & Development: Improving Children's Lives, Maximizing their abilities, June 8-9, 2017, Kathmandu, Nepal.

Curriculum Vitae

Worku BN & Shiferaw S, (2014). Trends and Factors of Mental Illness: The Case of Psychiatry Ward in Jimma University Specialized Hospital, Ethiopia. IACAPAP 21st World Congress, August 11-15, Durban, South Africa.

Worku BN, (2014). Play Therapy as a self-healing and life-skills enhancing tool for children under problematic situations: Two orphanages in Addis Ababa (Ethiopia) in focus. IACAPAP 21st World Congress, August 11-15, Durban, South Africa.

Abessa TG, Kolsteren P, **Worku BN**, Valy J, Lemmens J, Granitzer M, (2013). From Denver II to Denver II-Jimma: a simple child development screening tool adapted for use in the context of Jimma, South West Ethiopia. The Second Launching Ceremony of Jimma University VLIR Institutional University Cooperation, in the Jimma University, 31 March 2013, Jimma, Ethiopia.

Abessa TG, Kolsteren P, **Worku BN**, Valy J, Lemmens J, Granitzer M, (2013). Feasibility and reliability of the Denver II-Jimma. The Second Launching Ceremony of Jimma University VLIR Institutional University Cooperation, in the Jimma University, 31 March 2013, Jimma, Ethiopia.

ACKNOWLEDGEMENT

Glory is to God (Holy Savior-'Rabbi Jabaa') for giving me the strength to accomplish this PhD project. There are several people who greatly contributed to this work. Primarily, I am highly grateful to my supervisor, Prof. dr. Marita Granitzer, for her spectacular support. Marita, nobody has been more important to me in the pursuit of this project than you. You believed in me, understood me, cared for me, shaped this project, supervised me well throughout, and finally, you made this happen.

My earnest gratitude goes to Prof. dr. Patrick Kolsteren, co-supervisor, of Ghent University. His valuable comments and clear directions starting from the very inception of this project helped me progress well and publish papers. Dr. Liesbeth Bruckers deserves my profound appreciation for her warmth, patience, great contribution in data analyses and in producing the papers documented in this dissertation. Further, Prof. dr. Marleen Vanvuchelen, Prof. dr. Eugene Rameckers and Prof. dr. Paul Janssen, from Hasselt University, provided me worthwhile comments, which helped me shape my work in a better way. They truly earn my ardent gratitude. The following external jury members—Prof. dr. Caroline Bastiaenen, Maastricht University,The Netherlands; Prof. dr. Lien Goossens, Ghent University, Belgium, and Prof. dr. Tefera Belachew, Jimma University, Ethiopia—rightly deserve my many thanks for their great comments and queries, which helped me shape and finalize the dissertation. I am appreciative of all the co-authors in my papers— Dr.Teklu Gemechu Abessa, Dr. Mekitie Wondafrash, Dr. Liesbeth Bruckers, Prof. dr. Marleen Vanvuchelen, Evelien Franssen, Jan Valy and Johan Lemmens. Special

thanks to Jan Valy and Johan Lemmens, from the Department of Healthcare, PXL University College, Belgium, for their all-round support and for making me feel at home! My gratitude goes to Anniek Orye, from the PXL University College, Belgium, for her participation in supervising the home-visit and providing useful feedback. I also would like to thank Marc Thoelen, Dr. Stefanie Kerkhofs and Veronique Pousset for their amazing support with the administrative matters. Eva Cordery of Hasselt University also deserves my deep gratitude for her language revision of my papers and final dissertation. Her contributions were immense and I cannot thank her enough. I would also like to impressively thank Dr. Yimer Wasihun and Dr. Tadesse Awoke, my Ethiopian friends whom I have known at Hasselt University. The two of them have great personalities and always passionate to help others, including myself.

I really thank SOS Village-Jimma, and Jimma town's Women and Children's Affairs Office staff (from top to bottom) for believing in this project, owning it, and for providing the professional and practical support needed. Caregivers of children who participated in all the studies under this project earn many thanks. I am exceedingly grateful to VLIR: IUC-JU and BOF-Bilateral Scientific Cooperation (Hasselt University) for the financial support. This backing was what made this PhD project a reality. Assessors or data collectors (clinical nurses)—Konje Taye, Tirumirt Assefa, Amelework Regassa and Abeba Gemtesa—and intervention workers (clinical nurses)—Zaferan Mussa, Fitsum Zewde, Leyila Mohammedzen and Bachu Nemera—deserve my heartfelt appreciation. I am also enormously thankful to the assistant project coordinators—Amin Mohammed and Yahiya Temam—and the supervisor, Amele

Tamiru. Your motivation, commitment and sense of belonging to the project helped the successful completion of this project.

It is with strong reasons that I always say that Belgium is my second country; I have three captivating and caring families here. Jan, Els, Silkie and Sien, you are simply amazing and I really mean it. We have had dinner and went to events as one family. All these were my sources of energy and the smile on my face; you know it! Oh, one more thing, Jan you are the best cook I have ever known, and Els, memories from my all day visit to your school are still fresh. I am also abundantly thankful to Johan Lemmens, Marion (his wife) and the kids—Jinte and Joran! Among others, the birthday parties with the houseful of relatives and close friends were my favorites. Johan, what about the forest-walk the next day early in the morning the two of us with Danny Lemmens? In the middle of the forest, sitting under that graceful big tree (SEQUOIA), we drank coffee first and next that especial drink (AMARETTO or LIMONCELLO): what a ritual, what a feeling! Wow, unforgettable! Marion, for the first time in my life, it was you who made me pancakes; they were so delicious! My third family is Prof. dr. Marita's (my supervisor's), her husband (prof. dr. Frank Van Assche) and her sons. I am exceptionally appreciative of the wonderful support I received, and invitations I enjoyed. Talking of invitations, I will never forget the mouthwatering goulash I had a couple of times at your home. Above all, Marita, the gift I (Sarah Mingels too) received last Christmas had a great place in my stay in Belgium. I owe you great respect and lots of credit. Sarah Mingels was very motivational for me, and she deserves my gratitude. Who else made my stays in Belgium more meaningful and unforgettable? All the volleyball team members—Beunckens Joris, Geraerts Benny, Gerimont Serge, Huygen Mark,

Acknowledgement

Jackers Rudi, Leesen Benny, Lehaen Bernard, Mellaerts Frank, Nuyts Gert, Opdekamp Ewoud, Peters Jan, Peters Leon, Roox William, Sauwens Karel, Sillen Kristof, Sillen Ludo, Valy Jan and Vandormael Paul. We played hard, but with good humour, and had drinks afterwards. What a special team and an enjoyable time!

Administratively, throughout this PhD work, I had been receiving vigorous support from Kassahun Ebba, Jaleta Abdisa, Yetinayet, Kebebush and all the drivers. Your contributions were lavish; many thanks for your services.

My parents and siblings have been inspirational and very helpful to me. Many thanks to my father (Shankooru), mother (Abayyee), eldest brother (Engr. Reta Nigussie), elder brother (Dr. Mesfin Nigussie) and my little sister (Aster Nigussie). My brothers, you paved the academic way for me, sparked my interest, positively influenced me and finally, told me that the sky is the limit. Here we go; haven't I reached there yet? Geni, my darling, many thanks for your persistence.